MANITOBA ENERGY & MINES

AGGREGATE REPORT AR84-4

SURFICIAL GEOLOGY AND AGGREGATE RESOURCE INVENTORY OF THE RURAL MUNICIPALITY OF VICTORIA

DECEMBER 1984

the uma group

Underwood McLellan Ltd.

Consulting Engineers and Planners

86-02622/

ERRATA

AGGREGATE REPORT AR84-4

The Lennard Till is incorrectly described in the text. The till within the municipality is a calcareous till deposited by ice originating from the northeast.

MANITOBA ENERGY AND MINES

SURFICIAL GEOLOGY AND AGGREGATE RESOURCE INVENTORY OF THE RURAL MUNICIPALITY OF VICTORIA

AGGREGATE REPORT AR84-4

DECEMBER 1984

PREPARED BY:

Underwood McLellan Ltd.
Consulting Engineers and Planners
1479 Buffalo Place
Winnipeg, Manitoba
R3T 1L7

Underwood McLellan Ltd.

1479 Buffalo Place
Winnipeg, Manitoba R3T 1L7
Telephone (204) 284-0580

Our File: 41 06 1601 023 01

December 20, 1984

Mineral Resources Division
Manitoba Energy and Mines
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 4E3

Attention: Mr. W. A. Bardswich
Director of Mines

Dear Sir:

Re: Surficial Geology and Aggregate Resource
Inventory of the Rural Municipality of Victoria

We are pleased to submit our report on the surficial geology and aggregate resources of this area. The submission includes a written report plus a detailed map of the surficial geology and sand and gravel deposits of the area. We trust that the findings of this report will be helpful in the planning and management of these resources.

We would like to thank you for the opportunity to participate on this interesting project and we look forward to working with you again in the future.

Yours truly,

UNDERWOOD MCLELLAN LTD.

R. Hood, P.Eng.
Vice President & Manager
Manitoba & Northwestern Ontario

T. Wingrove, P.Eng.
Director
Earth Sciences Division

LB/dh

SUMMARY

The majority of the Rural Municipality of Victoria is a lacustrine plain. The plain consists of silty sands and sandy silts with sand dunes covering large tracts to the north and west. The Assiniboine and Cypress Rivers cut the plain in the north and in the west respectively. Large volumes of alluvial sand are associated with these valleys. A till plain and till moraine are located to the south and consist of a grey calcareous silty clay till. Shale bedrock occurs at or near the surface throughout the till plain and till moraine.

Small isolated pockets of gravel are associated with the alluvial flood plain granular deposits of the Assiniboine River. These small pockets contain medium to high quality material and are surrounded by large volumes of low quality materials. Small outwash deposits are found within the till moraine which contain medium to high quality materials.

Total aggregate reserves in the study area are estimated at 15.5 million cubic metres and consist predominantly of sand. The estimate of medium to high quality material is less than 0.2 million cubic metres. This figure may be reduced by factors such as geologic variation and uneconomic stripping ratios. Aggregate usage is estimated to be approximatley 12,000 cubic metres per year.

The Department of Highways and the private and commercial sector are both presently obtaining their requirements from outside the municipal boundaries. The needs of the municipality are being satisfied from within the study area but these known supplies have a limited life span of only five to ten years, assuming current rates of extraction. The discovery of new isolated deposits would extend this time frame. This study shows that all three aggregate users will soon be importing their required aggregate supplies.

TABLE OF CONTENTS

		PAGE NO.
Summary		
1.0	INTRODUCTION	1
1.1	Purpose and Scope of the Study	1
1.2	Location of the Study Area	1
1.3	Methodology	3
1.4	Presentation of Data	5
1.5	Acknowledgements	6
2.0	SURFICIAL GEOLOGY	7
2.1	Physiography	7
2.2	Bedrock Geology	10
2.3	Quaternary Deposits	12
2.3.1	Stratigraphy	12
2.3.2	Glacial Deposits	12
2.3.3	Post-Glacial Deposits	17
2.3.4	Recent Deposits	18
2.4	Quaternary History	20
3.0	SAMPLING PROGRAM	22
3.1	General	22
3.2	Field Reconnaissance Program	22
3.3	Conductivity Survey Program	22
3.4	Backhoe Test Pit Program	23
4.0	AGGREGATE RESOURCES	25
4.1	Aggregate Deposits	25
4.1.1	General	25
4.1.2	Alluvial Floodplain Deposits	25
4.1.3	Isolated Outwash Deposits	26
4.1.4	Shale Bedrock	26
4.2	Aggregate Reserves	26
4.3	Demand and Use of Aggregate	30
4.4	Supply Versus Demand	32
REFERENCES		
APPENDIX A - Location and Profiles of Conductivity Surveys		
APPENDIX B - Summary of Test Pit Logs		
APPENDIX C - Computer Forms		
APPENDIX D - Example of Computer Printout		
APPENDIX E - Summary of Deposit Data		

Table of Contents (cont'd)

LIST OF FIGURES	PAGE NO.
Figure 1 - Location Plan	2
Figure 2 - Physiography	8
Map AR84-4 - Surficial Geology of the Rural Municipality of Victoria	(in pocket at back)

LIST OF PHOTOS

Photo 1 - Glacial till plain and till moraine	9
Photo 2 - Glacial meltwater channel	11
Photo 3 - Eolian sand dunes	11
Photo 4 - Glacial till overlying shale bedrock	13
Photo 5 - Shale bedrock	13
Photo 6 - Glacial till	16
Photo 7 - Silty sand - littoral and nearshore deposits	19
Photo 8 - Sandy silt - offshore deposits	19
Photo 9 - Alluvial floodplain sand and gravel	27
Photo 10 - Isolated outwash deposit	27

LIST OF TABLES

Table 1 - Summary of geological units	15
Table 2 - Summary of total reserves	28
Table 3 - Summary of medium and high quality reserves	29

1.0 INTRODUCTION

1.1 Purpose and Scope of the Study

Underwood McLellan Ltd. were retained by Manitoba Energy and Mines to conduct a Surficial Geology and Aggregate Resource Inventory of the Rural Municipality of Victoria. The objectives of this inventory were to: map and characterize all surficial geology deposits within the study area; map and determine the quantity, quality and distribution of all sand and gravel deposits; and determine existing and projected demand and use for sand and gravel within the study area.

The scope of the study was defined in our proposal, dated March, 1984, and was based on the "Terms of Reference" prepared by the Mineral Resources Division of Manitoba Energy and Mines. The scope of the work was divided into three phases and involved:

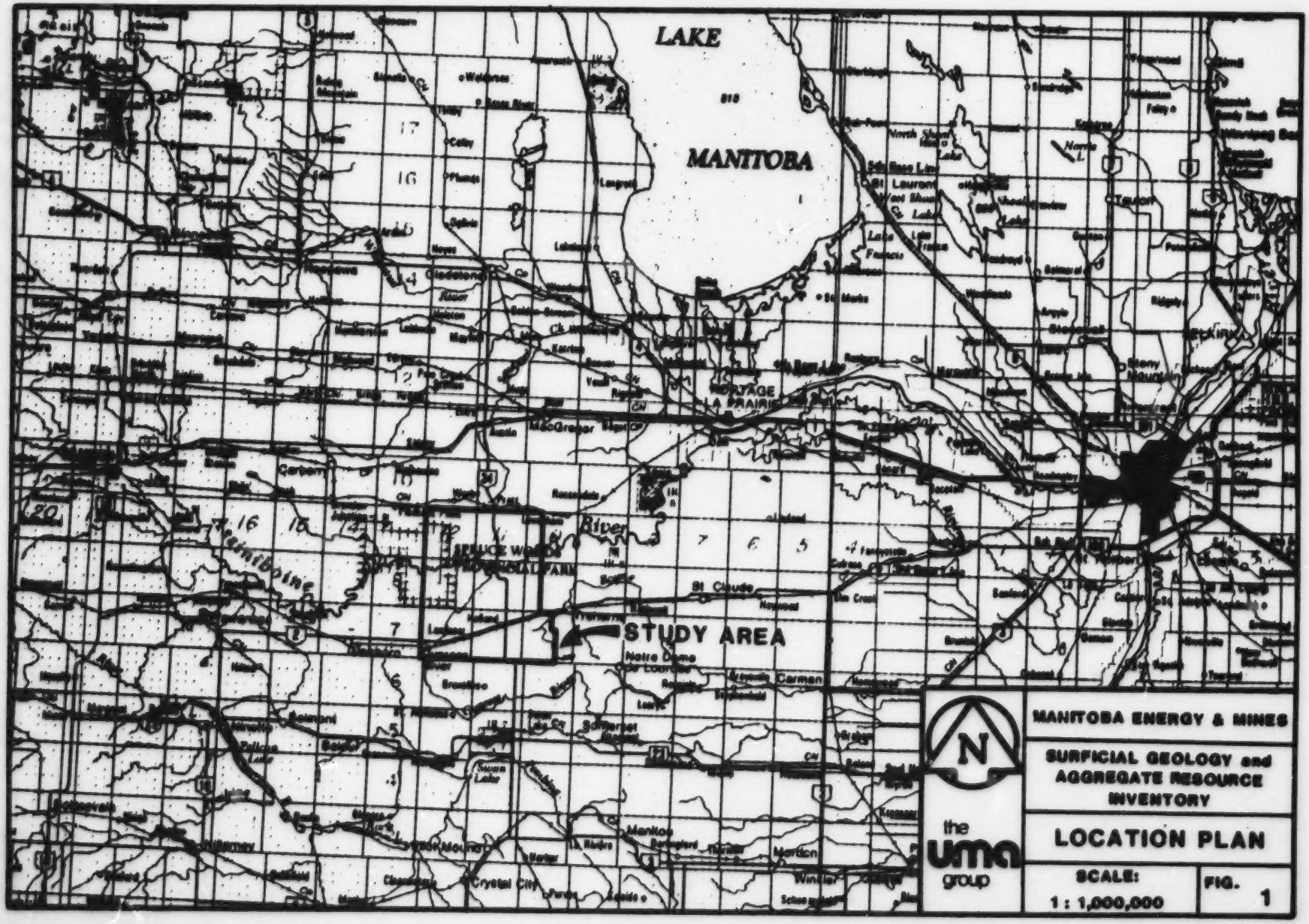
I. Compilation of existing relevant data and preliminary air photograph interpretation.

II. Field investigation including detailed sampling, reconnaissance, conductivity surveying, test pitting, gradation analysis and petrographic evaluation.

III. Map preparation and report writing.

1.2 Location of the Study Area

The Rural Municipality of Victoria, as shown in Figure 1, is located in south-central Manitoba approximately 120 kilometres west of Winnipeg. The study area covers 675 square kilometers extending between Townships 7 and 9 and Ranges 10 to 12 west. The area includes the western edge of the Spruce Woods Provincial Park and the towns of Holland and Cypress River. Access to the area is


LAKE
MANITOBA
STUDY AREA
MANITOBA ENERGY & MINES
SURFICIAL GEOLOGY and AGGREGATE RESOURCE INVENTORY
LOCATION PLAN
SCALE:
1 : 1,000,000
FIG. 1
the uma group

provided by Provincial Highways 2 and 34 plus many secondary provincial and municipal roads. The area is also served by a Canadian Pacific Railway line in the south.

1.3 Methodology

The initial phase of the study involved the compilation of existing relevant data and preliminary air photo interpretation. Information from all potential sources was evaluated and a detailed chronology of the depositional history and stratigraphy was established. Original air photo interpretation was used to produce a preliminary surficial geology map of the study area and to identify aggregate sources and existing pits. Air photos at a scale of 1:50,000 were used for general mapping purposes with air photos at a scale of 1:15,840 utilized to improve the detail on the sand and gravel deposits.

An extensive field reconnaissance of the entire area was undertaken to refine the preliminary surficial geology map, both in terms of unit boundaries and developing more detail on the type and origin of sediments in the area. All accessible areas were visited in the field and original air photo interpretations verified. Relevant exposures illustrating the Quaternary history and the various surficial geology units were described in detail, photographed and noted on the preliminary map for future reference. Air photos were re-examined on the basis of the ground truthing and the surficial geology map was finalized.

Sand and gravel deposits and/or existing pits were identified and delineated during the original air photo interpretations and visited during the reconnaissance program. Non-contacting conductivity surveys were carried out to establish the lateral extents of some of the existing deposits and to locate new

deposits of a similar nature. Profiles of the survey results were drawn (Appendix A) and analysed for aggregate resource potential.

A sampling program was developed using information from air photo interpretations, site reconnaissance, conductivity surveys and Department of Highways aggregate records. Backhoe test pits were utilized for the collection of channel samples, exposure descriptions, and exploration of new aggregate prospects. Each test pit exposure was logged (Appendix B) and described in detail using Mineral Resource Division data forms 1-3 (Appendix C).

The majority of information was recorded directly onto the data forms at the exposure site. Form 1 was used to outline the deposit area, depth and percent of depletion for the calculation of reserve volumes. Form 2 describes the basic lithology, deleterious substances, height of stratigraphic section and estimated gravel content at each deposit exposure. Form 3 was filled out during laboratory testing summarizing the sieve analysis results of the granular samples collected during the field program.

The three computer forms were submitted to the Mineral Resources Division and were processed by their computer system "PLSTCNG". The system calculates the reserve volume, grain size parameters and outputs a quality assessment for each deposit and exposure. An example of the output for one deposit is presented in Appendix D. A summary of all the deposit data is contained in Appendix E.

Deposit and exposure sites were identified by a unique numbering system. Each deposit was assigned a four digit number starting at 7200 and increasing in numerical order west to east and north to south. Deposits of similar origin but with distinct variations in quality were assigned the same deposit number but designated as

sub-units A and B. Sites visited within a particular deposit were denoted as exposures and assigned three digit numbers preceeded by the letters TP. If the exposure was sampled a letter S appears after the exposure number. Locations of all sites are shown on the surficial geology map AR84-4.

The demand and use of aggregate in the municipality was assessed by surveying the local towns, railways, municipal office and Department of Highways regional office. Base data on the historic and future demand for aggregate in the area was obtained for a period of five years and a relationship was developed between supply and demand.

1.4 Presentation of Data

The information obtained during this study is presented in the published report and accompanying map.

The present report provides a description of the Quaternary stratigraphy and Quaternary events in the region and is illustrated by appropriate photographs. The distribution of high, medium and low quality resources is discussed and a tabulated summary of sand and gravel deposits by quality and ownership is given. The supply and demand of aggregate within the study area is also discussed.

A 1:50,000 scale map of the area illustrates the Quaternary geology and bedrock exposures. It emphasizes all sand and gravel deposits and indicates any existing pits and quarries. The quality of each granular deposit is indicated as well as all field data sources.

A data file contains all of the working notes, records, maps and air photographs used during this study. This file may be obtained

through the Aggregate Resources Section of the Mineral Resources Division in Winnipeg.

1.5 Acknowledgements

Underwood McLellan Ltd. would like to extend its appreciation to all of the individuals who helped make the completion of this study a success. Mr. R. V. Young and his staff at Mineral Resources Division who provided assistance during all phases of the study. Mr. B. Anaka and Mr. E. Hayward who provided information from the Manitoba Department of Highways. The secretary treasurer of the municipality for providing information on gravel consumption within the municipality. All of the land owners who allowed us access to their properties.

The Underwood McLellan Ltd. study team consisted of:

T. Wingrove, P. Eng.
L. Bielus, E.I.T.
T. Hunter, C.E.T.

2.0 SURFICIAL GEOLOGY

2.1 Physiography

There are four physiographic divisions within the Rural Municipality of Victoria. These consist of a till moraine, till plain, lacustrine plain and major river valleys (Figure 2).

The till moraine is situated along the north flank of the Darlingford Moraine and exhibits over 100 m of relief (Photo 1). The lowest elevation of 380 m.a.s.l. occurs along the northern boundary with the highest elevation occurring in the southeastern corner at 495 m.a.s.l. Local relief of 5 - 15 m occurs on isolated till knolls. The moraine contains a series of parallel discontinuous curvilinear ridges that trend from northwest to southeast. These ridges along with the entire moraine unit are cut by a glacial meltwater channel (Photo 2). The till ridges and meltwater channel are shown on the accompanying surficial geology map, (AR84-4). Numerous road cut exposures show shale bedrock near ground surface throughout the moraine. This implies that much of the topography is bedrock controlled.

The till plain is generally a flat lying feature with a slight slope from south to north (Photo 1). It displays less than 5 m of local relief and is situated adjacent to the till moraine. Shale bedrock occurs at or near the surface with only a thin till veneer.

The lacustrine plain is the major physiographic division within the study area. It is referred to by Klassen (1975), as the Assiniboine Delta. The plain is generally flat lying with a slight slope to the north. The overall elevation change is approximately 10 m. In the north and west sections of the study area, the majority of the plain has been reworked by eolian processes into sand dunes (Photo 3). These dunes have been

SCALE: 1:250,000

0 5 10

kilometers

LEGEND

- LACUSTRINE PLAIN – low relief, areas of sand dunes
- MAJOR RIVER VALLEYS – steep sides, flat bottom
- TILL PLAIN – low relief, meltwater channel
- TILL MORAINE – moderate to high relief, till ridges

Underwood McLellan Ltd. Consulting Engineers and Planners	the uma group	MANITOBA ENERGY & MINES SURFICIAL GEOLOGY AND AGGREGATE RESOURCE INVENTORY PHYSIOGRAPHY R. M. OF VICTORIA	FIG. 2

Photo 1
Glacial till plain with till moraine in the background, 2 kilometres east of Holland.

developed parallel to one another in a southeast direction. Local relief on the dunes is between 5 and 10 m. The location and direction of the dunes are shown on the surficial geology map.

The Assiniboine River occupies one of two river valleys within the study area. It is the larger of the two valleys and offers a striking topographic contrast to the surrounding flat plain. It displays over 70 m of relief and the valley varies between 1 and 3 km in width. The Cypress River occupies the other major valley in the area and also offers a sharp topographic contrast. It exhibits over 30 m of relief and the valley is usually less than 0.5 km in width. The river valleys are both generally steep sided features with flat bottoms. The existing rivers are both underfit

rivers which are presently meandering within old glacial meltwater channels.

2.2 Bedrock Geology

The study area is underlain by the Upper Cretaceous shales of the Riding Mountain, Vermilion River and Favel Formations (Halsteaad, 1959). Bedrock geology is illustrated on an inset to map AR84-4. The strata dip regionally to the southeast with an approximate gradient of 10 metres per kilometre. The bedrock surface is generally flat-lying, except in the south, where the Riding Mountain and Vermilion River Formations have been severely eroded by a glacial meltwater channel (Photo 2). The formations are covered by a veneer of overburden which varies from 0 - 10 m in the south to over 100 m in the north.

The Favel Formation is the oldest and least extensive of the three units. The formation is a grey shale with speckled white calcareous material thought to be fossil fragments, and bands of limestone located throughout the unit. One such key bed of limestone marks the separation of the formation into its two members, the Assiniboine and the Keld. No outcrop exposures of the formation were observed in the study area.

The Vermilion River Formation is the most extensive of the three units and includes three members, the Morden, Boyne and Pembina. They consist of various grey to black shale beds, both calcareous and non-calcareous, with a prominent series of bentonite beds at the base of the Pembina Member. Exposures of the formation can be seen in the southeastern corner of the study area in Sections 27 and 29, Twp. 7, Rge. 10W.

Photo 2

Glacial meltwater channel cutting through discontinuous till ridges, 4 kilometres southeast of Holland.

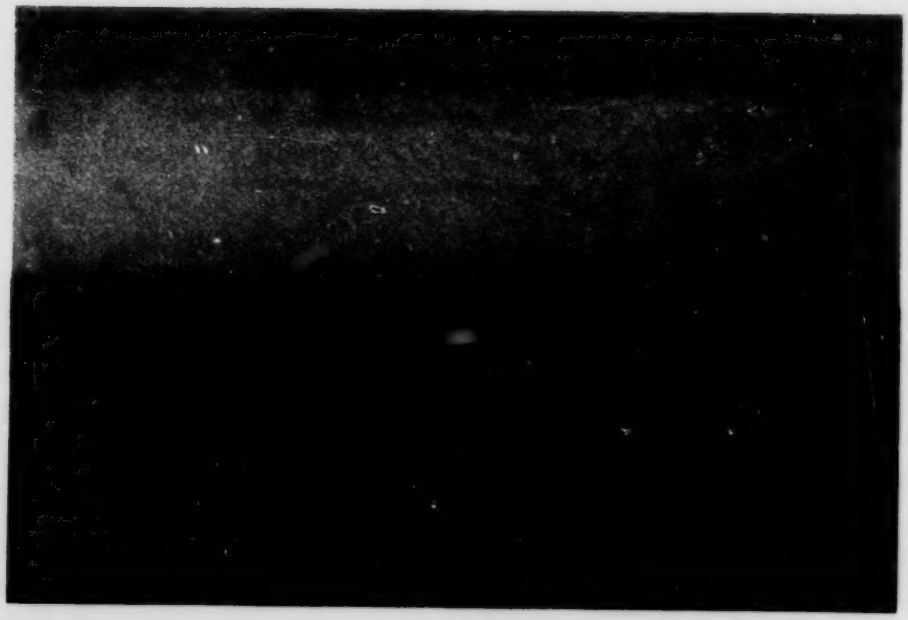


Photo 3

Eolian sand dunes bordering fluvio-lacustrine terrace, Sec. 31, Twp. 8, Rge 11W.

The Riding Mountain Formation is the youngest and most prominent of the three units. It consists of a hard, siliceous grey shale with thin beds of bentonite occurring at its base. Although massive in freshly exposed road cuts, the shale quickly weathers into fissile fragments. The formation can be seen in numerous road cut exposures and surface outcrops within the till moraine (Photos 4 and 5), and on the till plain. Locations of observed outcrops are noted on the surficial geology map.

2.3 Quaternary Deposits

2.3.1 Stratigraphy

The stratigraphy of southwestern Manitoba, which includes the present study area, has been established through detailed studies by Klassen (1969, 1975). A total of six stratigraphic units were identified during his studies which involved investigating outcrop exposures and drilled boreholes. The six stratigraphic units, observed by Klassen, consist of a layered sequence of three glacial and two interstadial or interglacial units, plus the post glacial and recent depositional sequence.

Within the study area only two of the six units are observed. They include the youngest till unit, known as the Lennard Till, and the post glacial and recent depositional sequence. A summary of the geological units in the study area is presented in Table 1.

2.3.2 Glacial Deposits

The Lennard Till was deposited by the last period of glaciation and represents a "classical Wisconsin" ice advance following an interstadial that began approximately 40,000 years ago (Klassen, 1975). This till unit is exposed in numerous road cuts and

Photo 4

Glacial till overlying shale bedrock. Evidence of till within shale unit, Sec. 15, Twp. 7, Rge. 10W.

Photo 5

Shale bedrock exposed at surface. Existing shale pit, Sec. 18, Twp. 7, Rge. 10W.

comprises the generally thin veneer of material which forms the till moraine, unit 2a, and till plain, unit 2b, located in the southern portion of the study area. The veneer of material is commonly 1 to 5 m thick and directly overlies shale bedrock (Photo 4).

Lennard Till is generally dark greyish brown or olive brown but varies in colour depending on the degree of oxidation. Exposures of this unit are shown on photos 4 and 6. Lennard Till is coarser and less compact than the till units outside the study area and usually more calcareous. It is comprised of 40 to 60 percent silt and clay and 30 to 50 percent sand (Klassen, 1969).

Pebble orientation measurements from the lowlands and uplands both indicate a strong northwest to southeast fabric (Klassen, 1969). This correlates quite well with the direction of the last ice advance and the orientation of the discontinuous till ridges located in the upland moraine. The till contains a high percentage of shale which was observed to be variable from one exposure to the next. The percentage of stones within the till is also quite variable. The till plain has a stone content of less than 5 percent while the moraine has a stone content greater than 5 percent.

The till moraine contains isolated deposits of outwash material. These deposits are quite small and were observed at only three locations, TP129, TP130 and TP131. These features are not manifested by air photo signature, nor was there any common factor to correlate between the three features. Additional isolated outwash deposits may exist in the till moraine but they are not predictable.

TABLE 1

SUMMARY OF GEOLOGICAL UNITS
IN THE
RURAL MUNICIPALITY OF VICTORIA

Age	Unit	Landform	Composition
Recent	Colluvium	Valley Slopes	sand, silt, clay
	Alluvium	Flood Plains	sand, silt, clay, organics
Post Glacial	Eolian Deposits	Sand Dunes	sand
	Offshore Deposits	Plains	sandy silt
	Littoral & Nearshore Deposits	Plains	silty sand
	Fluvio-Lacustrine Deposits	Terraces	clay, silt
Glacial	Till	Plain	silty clay
	Till	Moraine	silty clay
Cretaceous	Riding Mountain Formation	Bedrock	shale
	Vermilion River Formation	Bedrock	shale
	Favel Formation	Bedrock	shale

Photo 6

Glacial till, grey to brown calcareous silty clay, 6 kilometres southeast of Holland.

The deposition of Lennard Till was not a major erosive event. It was estimated that only a maximum of 3 m of shale bedrock may have been removed by the advancing ice (Klassen, 1969). Although not erosive, severe interaction did take place along the till/bedrock interface. Several of the contact exposures show ice push deposits within the shale bedrock (Photo 4). It is likely that high pressures from the glacial ice resulted in the bedrock becoming plastic, and wedges of ice frozen till were forced into the bedrock. With the decrease in heat and pressure when the ice melted, the bedrock once again hardened, trapping the till.

2.3.3 Post-Glacial Deposits

Post-glacial materials in the form of fluvio-lacustrine deposits, littoral and near shore deposits, offshore deposits and eolian deposits are present within the study area. These deposits are the most extensive land forms within the study boundaries, covering over three quarters of the area.

Fluvio-lacustrine deposits, unit 3, are found in the study area along the Assiniboine River as paired and non-paired terraces (Klassen, 1975). They range in size from broad flats nearly a kilometre wide and 4 kilometres long, to narrow ledges over 100 m wide. Their surfaces are slightly irregular and commonly marked by point bar ridges. They consist of clay and silt and vary in thickness between 5 and 10 m. The terraced deposits are usually bordered by eolian sands of unit 4C, (Photo 3). The terraces are found at various elevations which are representative of the fluctuations in the level of Lake Agassiz.

The remaining post-glacial deposits form part of the Assiniboine Delta complex which starts west of the study area near Brandon and continues east to Portage La Prairie. The delta complex was deposited as sediment laden meltwaters flowing through the Assiniboine valley emptied into glacial Lake Agassiz. Deposits in the study area become finer from west to east, consistent with deltaic sedimentation.

The littoral and nearshore deposits, unit 4a, cover a large majority of the study area. They consist of silty sand with minor amounts of clay (Photo 7). The unit is generally flat lying with a gently undulating topography. It was deposited during the later stages of the Assiniboine Delta complex with coarser material found to the west of the study area and finer material to the east.

The northern and mid-western regions of the unit contain large tracts of medium grained sand which have been reworked into sand dunes by northwesterly winds (Photo 3). The dunes were derived from the littoral and nearshore deposits but have been classified as eolian deposits, unit 4c, in this report. They have local relief which ranges between 5 and 10 m and they are generally stable.

The offshore deposits, unit 4b, cover a small section along the eastern side of the study area, just north of Holland. They consist of sandy silt occasionally interbedded with clay (Photo 8). The unit is flat lying with little or no relief. These deposits overlie the fine grained littoral and nearshore sands and represent the final depositional stages of the Delta complex.

2.3.4 Recent Deposits

Recent deposits found within the study area consist of alluvium, colluvium and organics.

Alluvium, unit 5, is found in all of the stream valleys within the study area with the exception of some locations along the Cypress River. Here steep, V-shaped valleys have been observed. The alluvium usually consists of fine to medium sand, clay and silt. Isolated pockets of coarser sand and gravel exist in the meander belts of the Assiniboine River.

Within these meander belts a division can be made between modern and old channel deposits (Klassen, 1975). Modern channel deposits include the lower sediments which are reworked during seasonal fluctuations in water level. The higher level sediments or older channel deposits are reworked only rarely, during periods of extremely high water levels. In this report both divisions are combined as one unit. A series of point bar ridges consisting of medium sand have also been observed in several of the meanders.

Photo 7

Silty sand of littoral and nearshore deposits located northwest of Holland, Sec. 15, Twp. 8, Rge. 11W.

Photo 8

Sandy silt of offshore deposits located northeast of Holland, Sec. 29, Twp. 8, Rge. 10W.

Colluvium, unit 6, is present along all of the valley slopes of the Assiniboine River and most slopes of the Cypress River. These slopes vary between 10 and 20 percent and are comprised of sand, silt and clay. Instability along the steeper slopes was occasionally observed by local occurences of slumping and sloughing.

Organics are common throughout the study area but have been combined with the alluvial materials due to their sporadic occurrences and generally small areal extent. The organics consist of peat, muck, marl and modern plant detritus.

2.4 Quaternary History

The Quaternary history of the R. M. of Victoria has been established over many years by several authors, and has recently been summarized by Klassen (1975). The various Quaternary units observed in the present study have been summarized in Table 1.

Lennard Till is the oldest and only glacial unit recorded in the study area. It was deposited during the last "late Wisconsin" ice advance covering the entire region with a thin veneer of till. The ice advanced in a southeasterly direction becoming stagnant approximately 12,000 years ago, (Klassen, 1969). This stagnation resulted in the formation of the Darlingford end moraine south of the study area. During the period of time that the ice sheet remained stagnant, glacial Lake Agassiz and the Assiniboine meltwater system were developed. The ice sheet then began its slow retreat to the north forming the discontinuous till ridges found in the moraine in the southern portion of the study area.

As the ice withdrew north of the study area fluvio-lacustrine terraces were deposited along the valley of the Assiniboine meltwater channel. With the retreat of the ice sheet, the quantity of meltwater was reduced and successively lower terrace levels were formed. The absence of intermediate terrace levels within the Assiniboine valley suggests that a fairly abrupt decline in the volume of meltwater occurred.

The shoreline of glacial Lake Agassiz also started to recede around this time period. The decline in the water elevation caused a subsequent decline in the available energy level, resulting in the deposition of the Assiniboine Delta complex. The complex starts at Brandon with the deposition of coarse sand and gravel and ends near Portage La Prairie with the deposition of fine silts and clays. In this study area silty sands and sandy silts are the main deposits of this delta system.

In post-glacial times, wind modification caused the development of sand dunes within the Assiniboine Delta complex. Stabilization of these dunes was dated at 3,600 years ago, (David, 1971), although some dunes are still active today. The Assiniboine River has developed broad flood plains and exhibits the characteristic meandering of an underfit river. The valley walls of both the Assiniboine and Cypress Rivers exhibit signs of ancient slope failures and active instability.

3.0 SAMPLING PROGRAM

3.1 General

The sampling program had three components:

1) a detailed field reconnaissance program,

2) an EM-31 conductivity survey program,

3) an extensive backhoe test pitting program.

3.2 Field Reconnaissance Program

Once the initial air photo interpretation was completed, a detailed field reconnaissance program was established. The program served two purposes. The first was to verify the air photo interpretations on unit boundary locations, material type and material descriptions. The second purpose was to investigate and delineate all existing gravel pits and potential new sites. The latter information was used to form the framework for the other two programs.

Existing pits were visited in the field and their areal extent delineated. The units depositional characteristics were noted as well as its relationship to the surrounding units and features. Similar relationships were then investigated in areas where there was no activity taking place. Potential sites were also selected based on past experiences of probable aggregate occurrence.

3.3 Conductivity Survey Program

The information obtained from the field reconnaissance program was

compiled and analysed. An EM-31 conductivity survey program was established, based on the conclusions of the above information. The conductivity program was implemented: to confirm lateral unit contacts; to attempt to isolate coarser portions of meander belts; to allow correlation of information in different meander deposits where backhoe work was not possible; and to investigate new aggregate deposits.

Six sites were investigated in the program. Three sites were in areas where existing pits were located and three sites were in areas with no previous activity. A total of 15 survey lines were completed, with two or three run at each site. The surveys were generally run parallel and perpendicular to the strike of each feature. The locations of these lines are shown on the surficial geology map. The profiles as well as detailed locations are presented in Appendix A.

The plots of the survey profiles indicated several locations where high resistivity values were obtained. These resistivity highs were generally found to correlate with the crests of topographic ridges, which were located on the meander flood plains. It was thought that these resistivity highs were an indication of higher quality material and were used as one of the guidelines for the test pit program which followed.

Survey locations were selected on the basis of accessibility as well as aggregate potential. Only a fraction of the meander belts were surveyed but it was felt to be a sufficient number to comment on the aggregate potential of the Assiniboine Valley alluvium.

3.4 Backhoe Test Pit Program

The backhoe test pit program was based on the results of the conductivity survey and reconnaissance programs. A total of 43

test pits were dug, 19 of which were sampled. The location of each test pit is shown on the surficial geology map and a summary of each log is presented in Appendix B.

Generally, one test pit was dug at each existing pit, with two or more exploratory test pits located outside the pit area. This was done in an attempt to delineate the areal extent of the deposit. Potential new deposits were investigated by placing test pits in areas identified to have the highest probability for containing aggregate. These probable areas were selected in features which were similar to existing deposits and in areas where high resistivity values were obtained from the geophysical surveys.

The results of the test pit program were generally negative. The areal extent of the existing pits were found to be the limit of the existing aggregate boundaries. Investigation of areas with features that are similar to those presently containing pits were found to contain no aggregate potential. Investigations based on locations containing resistivity highs were found to contain only low quality material.

4.0 AGGREGATE RESOURCES

4.1 Aggregate Deposits

4.1.1 General

The aggregate deposits of the Rural Municipality of Victoria can be grouped into two categories; alluvial floodplain deposits and isolated outwash features. The larger volume of the two categories are the alluvial floodplain depsoits which are located along the entire length of the Assiniboine River. The shale bedrock in the area has been used as an aggregate source, but it has not been included in the quantity estimates. The geology of these units has been discussed in the preceeding chapter. The following discussion will focus on the deposits as aggregate sources.

4.1.2 Alluvial Floodplain Deposits

The alluvial floodplains are generally flat lying features which are located within the Assiniboine River meanders. They consist of primarily fine to medium sand with isolated areas of coarser sand and gravel. These pockets occur in a random fashion with no distinct surface expression that could be used for their identification. Exploration of these deposits requires extremely detailed studies.

The areas of higher quality material are usually small in areal extent and vary in thickness between 2 and 3 m (Photo 9). The deposits were found to contain 35 to 75 percent gravel, 20 to 60 percent sand, 1 to 10 percent silt and clay and 5 to 10 percent shale. These figures are based on gradations of the collected samples which are summarized in Appendix E. Detailed sieve analysis data may be obtained through the Aggregate Resources Section Computer Data File (an example is presented in Appendix

D). The region immediately surrounding the higher quality deposits consists of low quality materials. These materials were found to contain less than 10 percent gravel, 50 to 95 percent sand and up to 40 percent silt and clay.

4.1.3 Isolated Outwash Deposits

The isolated outwash deposits are found within the till moraine, located in the southern part of the study area. These deposits are very small in areal extent and range in thickness from 1 to 3 m (Photo 10). These features also occur randomly with no distinct features that can be used for identification. Several similar looking features were tested with no significant results obtained. The material contained within these deposits consists of 50 to 70 percent gravel, 20 to 45 percent sand and 5 to 10 percent silt and clay. These deposits also contain between 20 and 30 percent shale.

4.1.4 Shale Bedrock

Shale bedrock has been quarried in the past as a form of aggregate for the less travelled roads in the municipality. Details on how much and when this material was used are unknown. There are three locations within the municipality where some quarry activity has occurred (Photo 5), one at Sec. 18, Twp. 7, Rge. 10W, and two in Sec. 12, Twp. 7, Rge. 11W, as shown on the surficial geology map.

4.2 Aggregate Reserves

The Rural Municipality of Victoria contains an estimated 15.5 million cubic metres of granular material, Table 2. Almost all of this material is located within the alluvial floodplain deposits and is generally of very poor quality. The estimation of higher quality material within these deposits is around 180,000 cubic

Photo 9
Alluvial flood plain sand and gravel deposit, TP 118.

Photo 10
Isolated outwash deposits within till moraine, TP 130

TABLE 2

SUMMARY OF TOTAL RESERVES
IN THE
RURAL MUNICIPALITY OF VICTORIA

Deposit Number	Landform Type	Estimated Reserves (m3)
7200	Floodplain	1,630,000
7201	Floodplain	2,859,750
7202	Floodplain	3,055,000
7203	Floodplain	1,680,250
7204	Terrace	1,589,000
7205	Floodplain	2,013,000
7206	Floodplain	2,258,750
7207	Outwash	16,000
7208	Outwash	16,000
7209	Outwash	322,500
	TOTAL	15,440,250

TABLE 3

SUMMARY OF MEDIUM AND HIGH QUALITY RESERVES
IN THE
RURAL MUNICIPALITY OF VICTORIA

Deposit Number	Landform Type	Estimated Reserves (m3)
7201A	Floodplain	18,750
7203A	Floodplain	20,250
7204A	Terrace	40,000
7205A	Floodplain	15,000
7206A	Floodplain	31,250
7207	Outwash	16,000
7208	Outwash	16,000
7209	Outwash	22,500
	TOTAL	179,750

metres, Table 3. This latter value is very approximate and should be used with caution. The above reserves were calculated by multiplying the estimated areal extent of each deposit by an approximation of the deposit's economic thickness. This method of quantity calculation likely overstates the actual amount of material available as it does not take into account variables such as; non-uniform thickness; local variations in material quality; pit management; or economic stripping ratios. Each of these factors would cause a decrease in the estimated total volume of high quality material.

The reserves estimated within the alluvial floodplains are based on the quantity of reserves located in deposits 7200 to 7206, as shown on the surficial geology map. They do not contain quantity estimates for the other meander belts. These other areas have not been tested but are presumed to contain similar deposits. The deposits studied within each meander belt, generally contain between 1.5 to 3.0 million cubic metres of lower quality material and potentionally 15,000 to 40,000 cubic metres of higher quality material.

The reserves estimated within the isolated outwash deposits located in the till moraine are based on the quantity of reserves located in deposits 7207, 7208 and 7209. These isolated features generally have an estimated potential of 20,000 cubic metres of higher quality granular material per deposit.

4.3 Demand and Use of Aggregate

The annual demand and use of aggregate in the Municipality of Victoria was investigated and summarized as part of the study. This information is required in order to develop an understanding of the relationship between supply and demand.

The annual demand estimates were based on recent municipal and Department of Highways usage records. Information was to be obtained from interviews with local gravel producers as well, but there were none in the study area. It appears, from discussions with local residents, that private or commercial supplies are obtained outside the municipality.

The quality of information obtained on the demand figures is quite good. Both the municipal and provincial governments keep up to date consumption figures. The general observations on aggregate demand and use within the study area are presented below. An analysis of the relationship between supply and demand follows.

The Rural Municipality of Victoria keeps exact monthly records on the amount of aggregate used in the study area for road maintenance. These figures were obtained from the municipal office and compiled for the last three years (last obtainable record). The total quantity calculated was averaged over the three year period and an annual usage figure was obtained. The average annual total is approximately 10,000 m3. This figure is a combination of road gravel, 9,000 m3 per year and winter sand, 1,000 m3 per year.

The Department of Highways also maintains exact monthly records on the amount of aggregate consumed within the study area. They have 30 kilometers of roadway in the municipality, which requires approximately 1,000 m3 per year of gravel for road and shoulder maintenance. They also require about 500 m3 per year of winter sand.

The above figures account for the recorded annual aggregate consumption within the municipality. They do not, however, represent the total demand for aggregate. The present consumption by the municipality is considered to be below their actual demand

due to the limited aggregate resources in the area. Frequently, quarried shale bedrock and coarser shale till have been used as a source of aggregate on some of the municipal roads which have limited traffic. The demand of the private and commercial sector, which is supplied outside of the study area, must also be considered in the total demand of aggregate.

These average annual consumption figures also cannot account for any major construction projects that may occur within the municipality in the future. These projects have pronounced effects on aggregate consumption and can deplete the equivalent of several years of average consumption within a short period of time. Several of the existing pits within the study area were depleted by the construction of Highway 34.

Although these factors cannot be taken into account in demand calculations their significance must be considered.

4.4 Supply Versus Demand

The supply of aggregate in the municipality is extremely limited. Deposits are only located within the alluvial floodplains of the Assiniboine River and in isolated outwash deposits of the till moraine. The resources are generally of poor quality with limited zones of medium to high quality material. These known higher quality zones are also substantially depleted. The possibility exists that there are more localized high quality deposits but finding them will require a detailed site specific exploration program.

The total estimate of reserves in the municipality is approximately 15.5 million m3, Table 2, which is predominently

lower quality material. An estimation of the reserves of medium to high quality materials is around 0.2 million m3, Table 3. As mentioned in a earlier section, this latter value likely overstates the actual volume of high quality material available. Uneconomic stripping ratios and bad pit management will also cause a reduction in the above volume of high quality material.

The Department of Highways own several of the semi-depleted pits in the municipality which they are currently only using for winter sand supplies, 500 m3 per year. All of their required road gravel, 1,000 m3 per year, is being hauled in from the surrounding municipalities. This practice has occurred for the past two years with no intention of changing it in the near future.

The municipality is presently supplying their demands from within the study area. Their requirements are approximately 10,000 m3 per year which they obtain from one pit. This pit, however, is quickly becoming depleted with a remaining life span of 5 to 10 years.

Private and commercial demands are relatively low and are supplied by gravel operators outside of the municipality boundaries.

In summary, the demand for aggregate in the municipality outweighs the available supply. The three areas of aggregate consumption in the area are the private and commercial sector, the Department of Highways and the municipality. Of the three, only the latter one obtains its supply of aggregate within the study area. Both of the other two users go outside the municipality for their supply of aggregate.

It is estimated that the municipality will deplete all known reserves in the area, within 5 to 10 years. The discovery of a new deposit would increase this time frame but not significantly. The likelihood of finding a major deposit is low and it appears as though both the municipality and Department of Highways will have to import their required materials in the future.

REFERENCES

David, P. P.

1971 The Brookdale Road Section and its significance in the chronoligical studies of dune activities in the Brandon Sand Hills of Manitoba. Geological Association of Canada, Special Paper Number 9.

Halstead, E. C.

1959 Groundwater Resources of the Brandon Map Area, Manitoba, Geological Survey of Canada, Memoir 300.

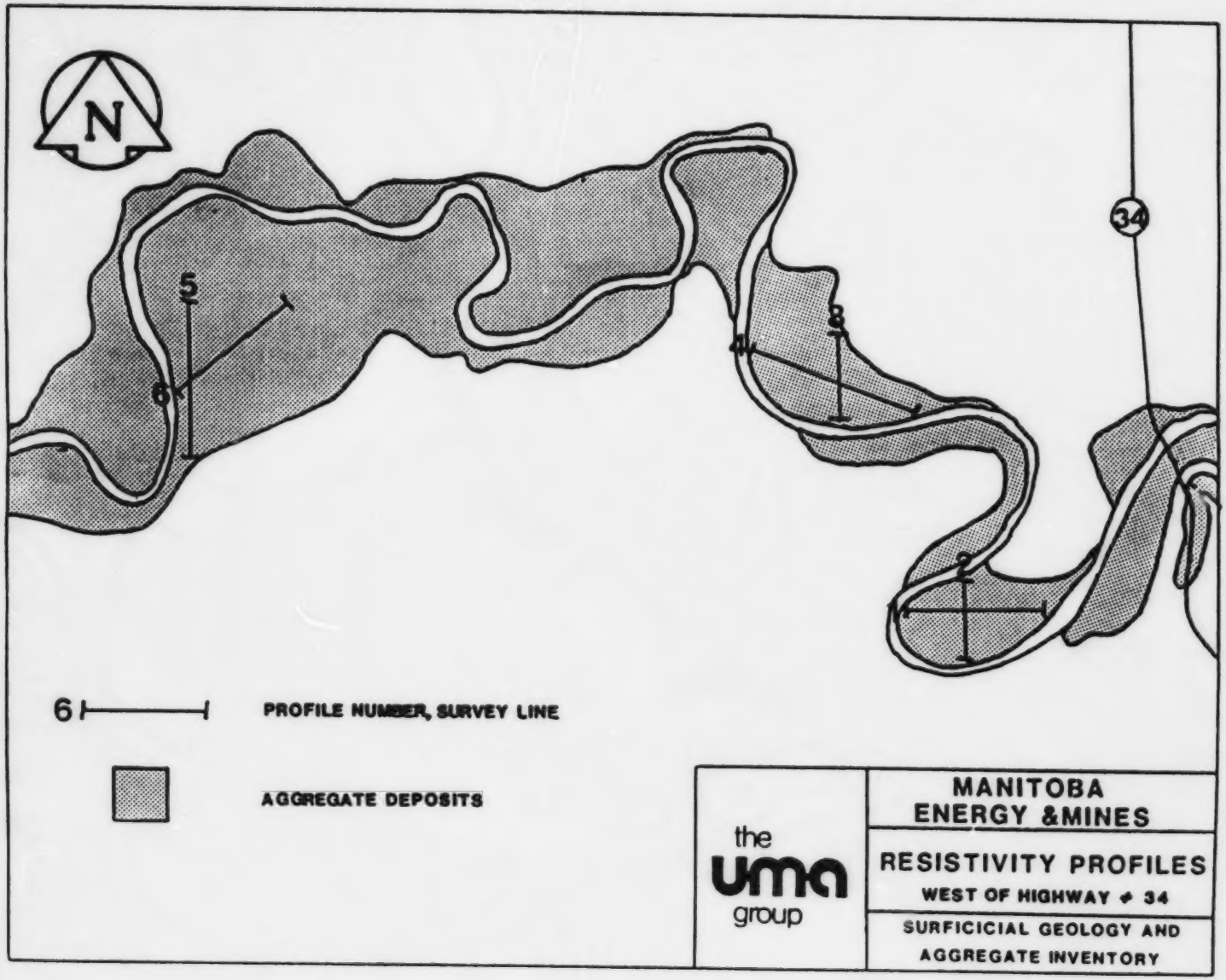
Klassen, R. W.

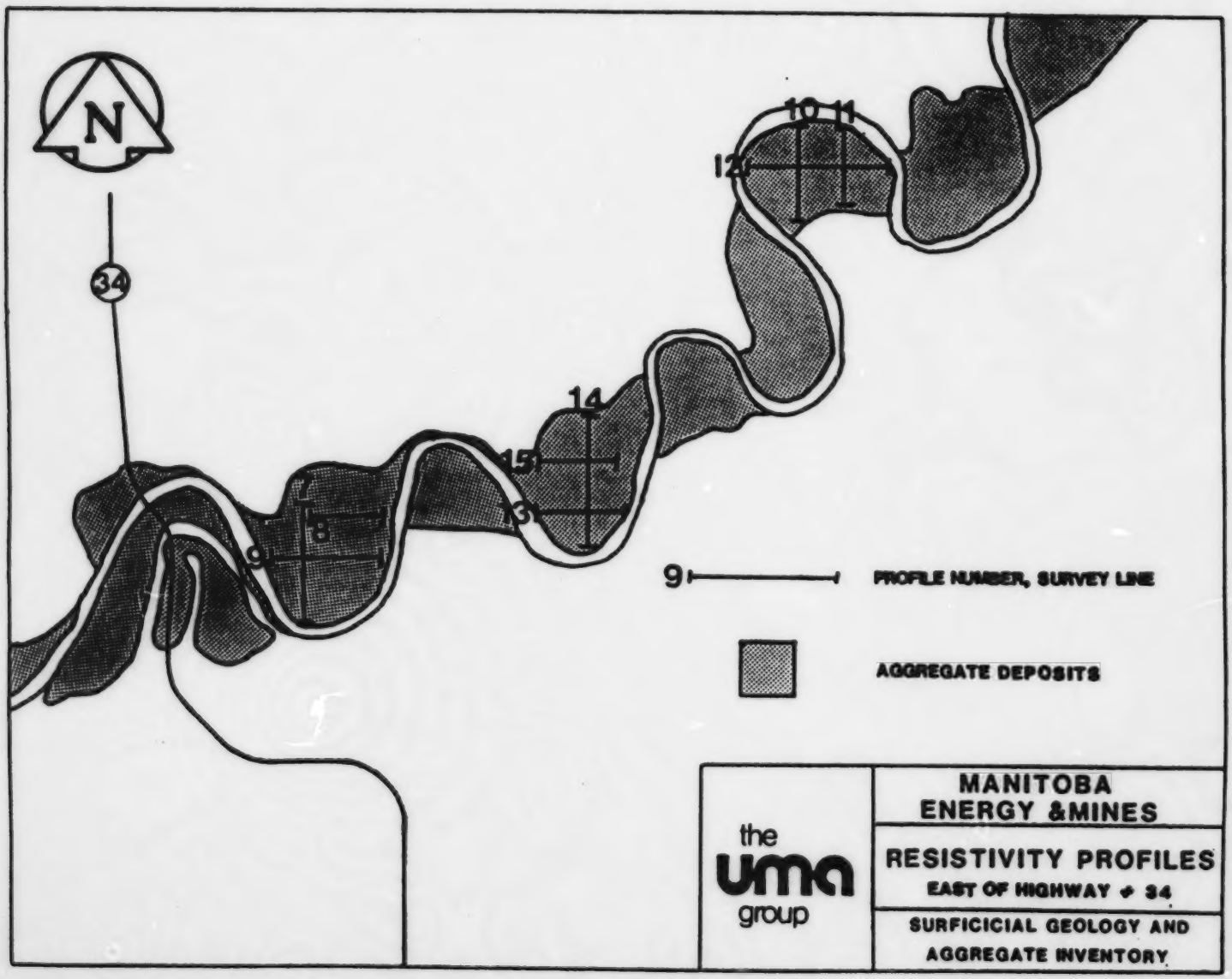
1969 Quaternary Stratigraphy and Radiocanbou Chronology in Southwestern Manitoba, Geological Survey of Canada, Paper 69-27.

1975 Quaternary Geology and Geomorphology of Assiniboine and Qu'Appelle Valleys of Manitoba and Saskatchewan, Geological Survey of Canada, Bulletin 228.

APPENDIX A

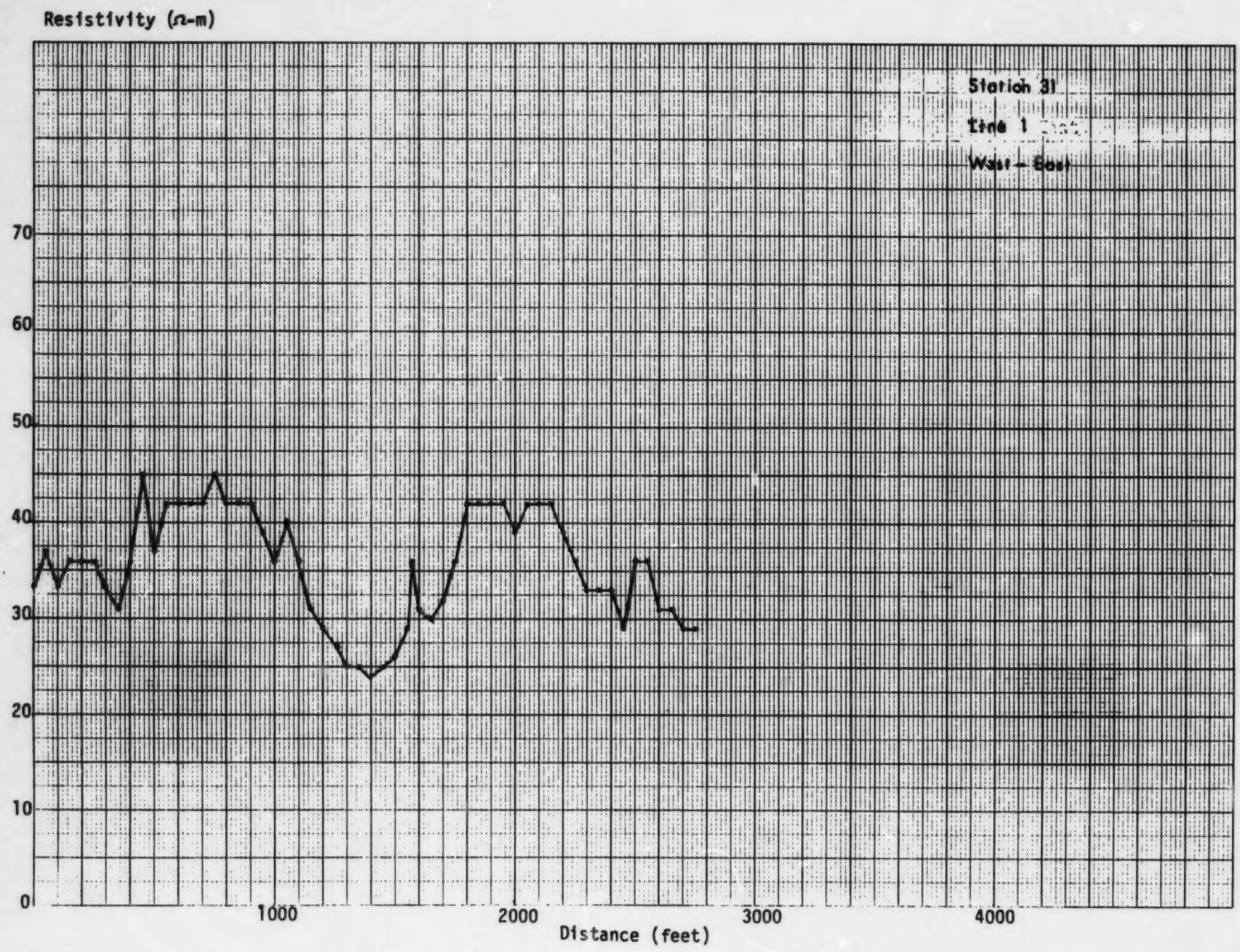
Location and Profiles of Conductivity Surveys


N
34
5
6
4
3
2
1
6
PROFILE NUMBER, SURVEY LINE
AGGREGATE DEPOSITS
the uma group
MANITOBA ENERGY &MINES
RESISTIVITY PROFILES
WEST OF HIGHWAY # 34
SURFICICIAL GEOLOGY AND AGGREGATE INVENTORY


N
34
9
13
14
15
12
10
11
9
PROFILE NUMBER, SURVEY LINE
AGGREGATE DEPOSITS
the uma group
MANITOBA ENERGY &MINES
RESISTIVITY PROFILES
EAST OF HIGHWAY # 34
SURFICICIAL GEOLOGY AND AGGREGATE INVENTORY

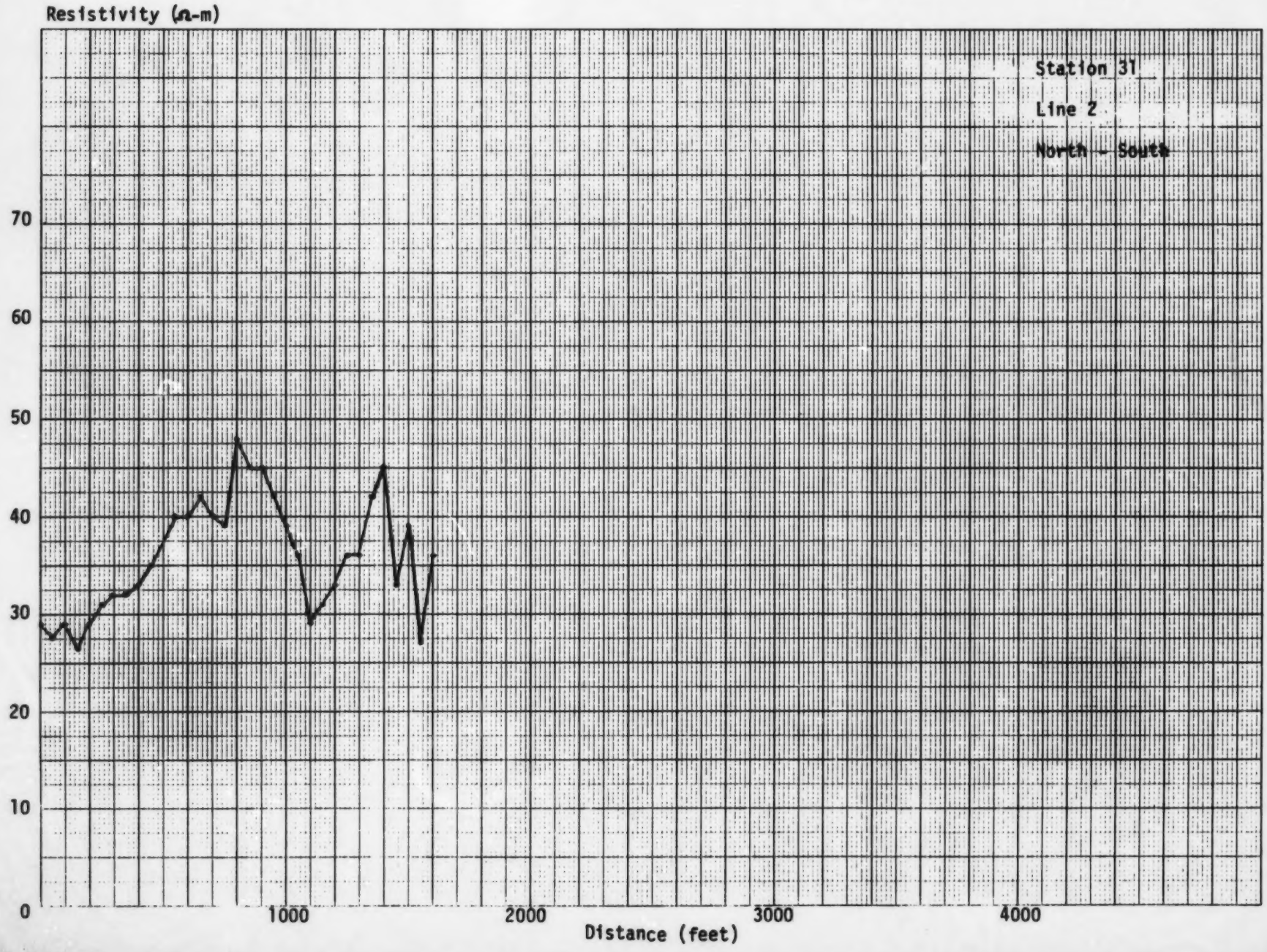
K•E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1510



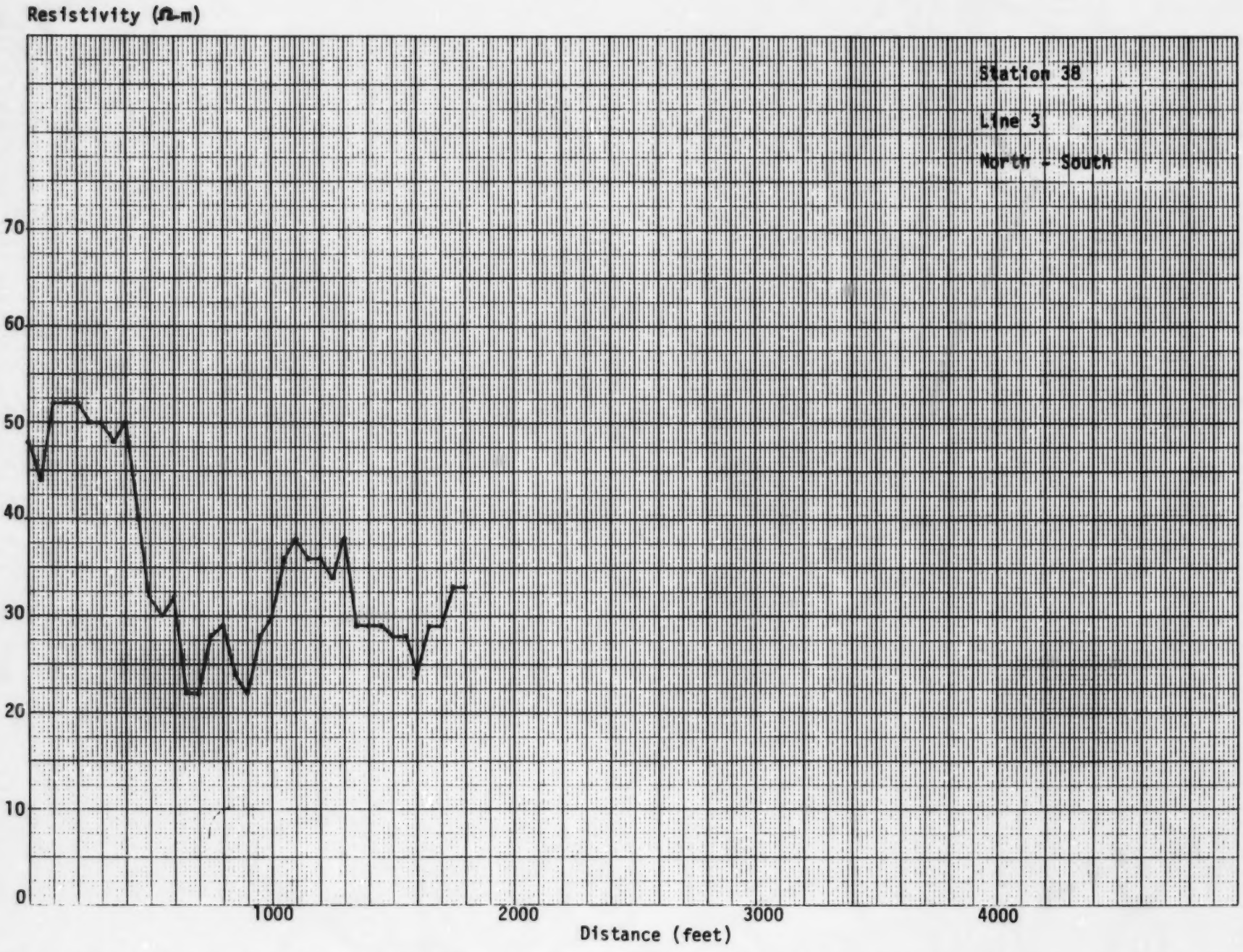
K•E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

461510



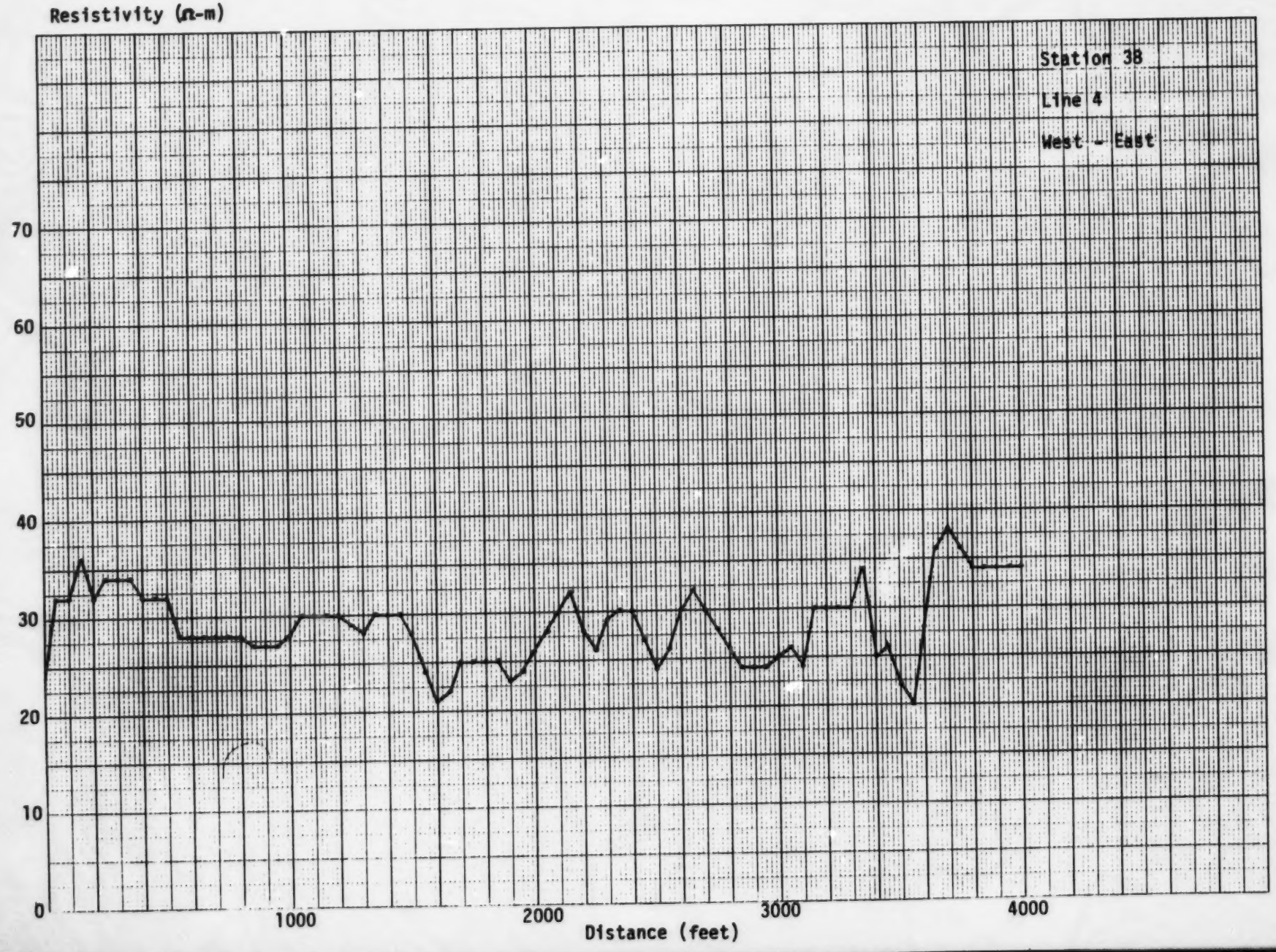
K•E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1510



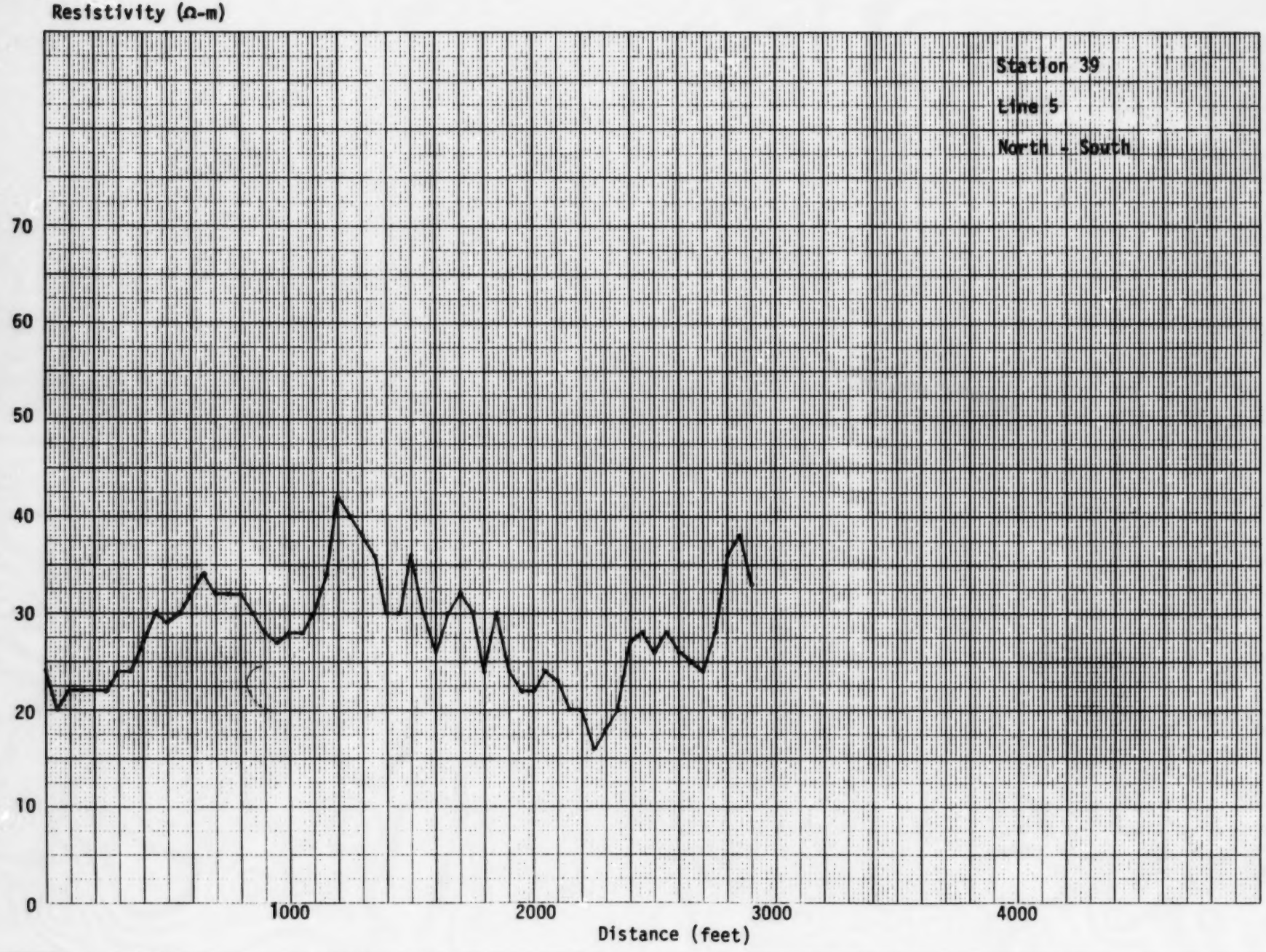
K•E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

461510

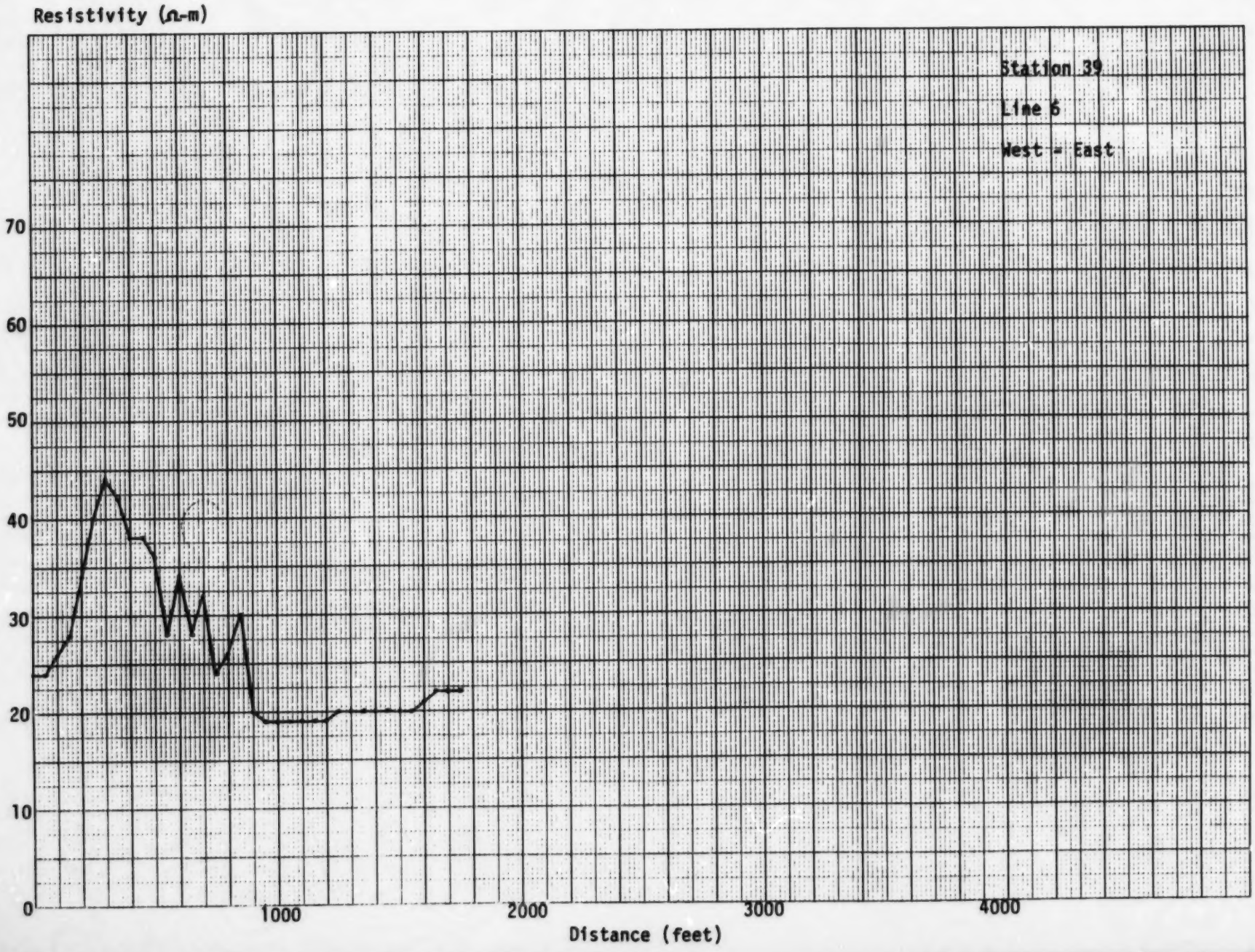


K•E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

461510

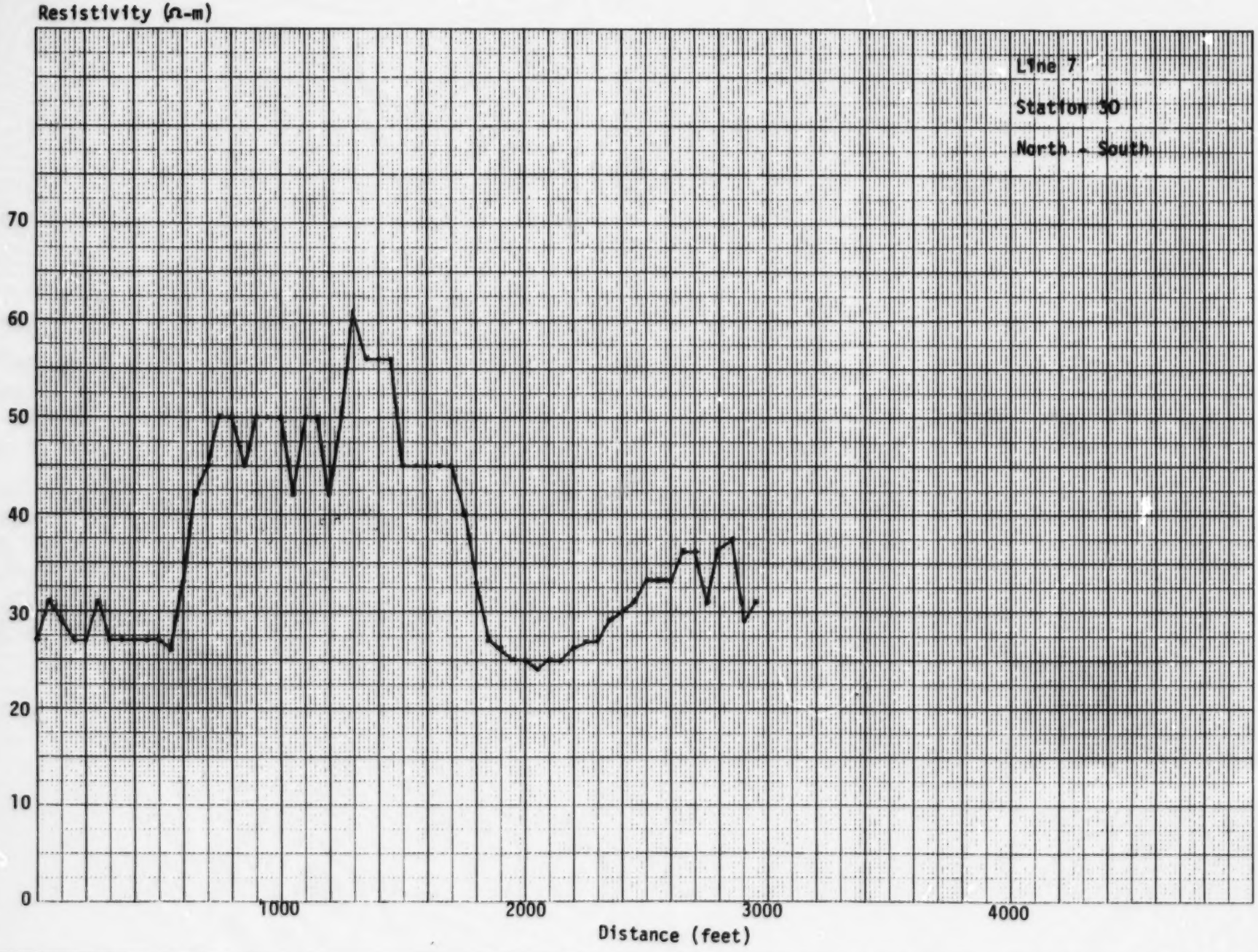


K•Σ 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO MADE IN U.S.A.

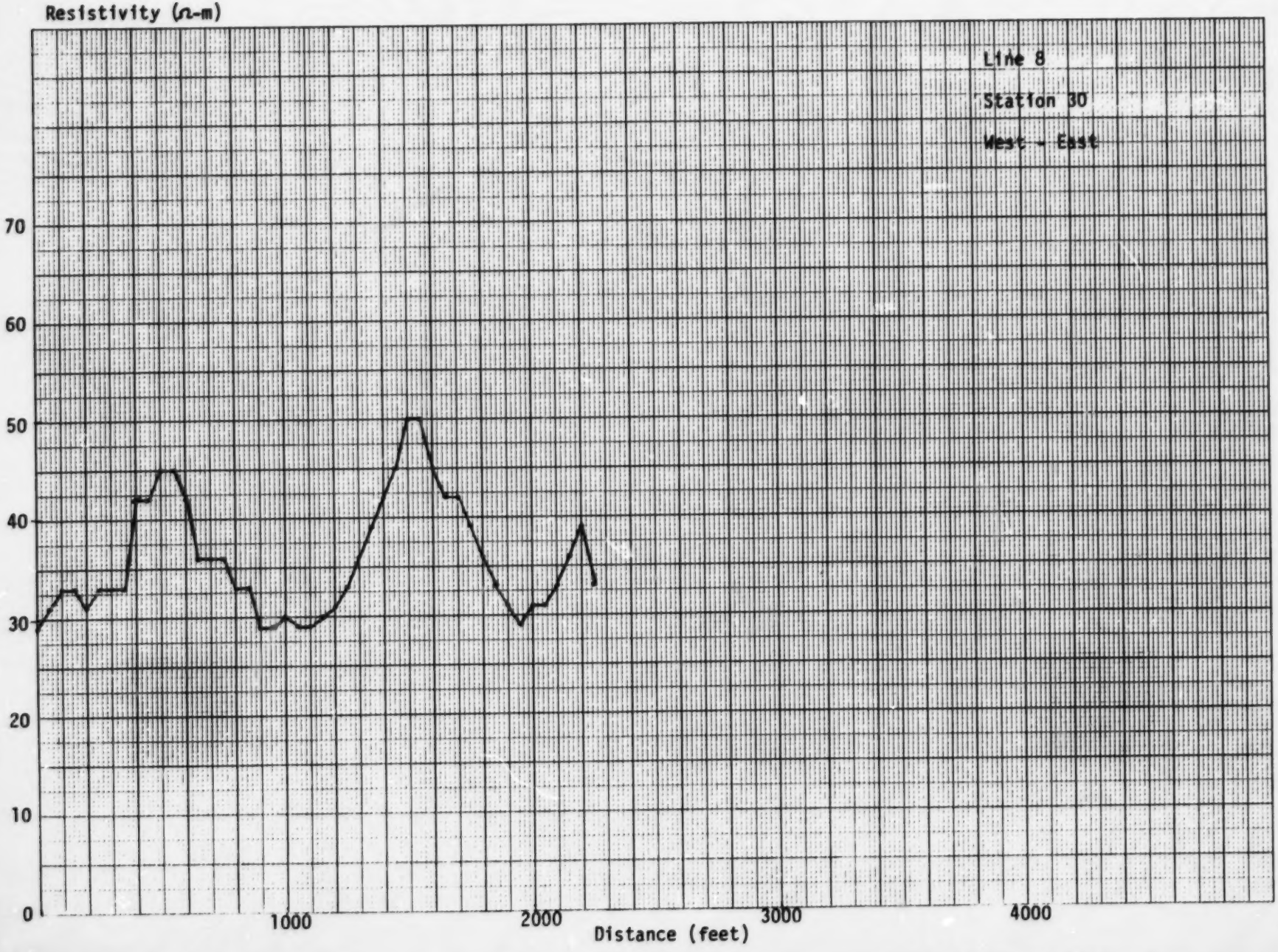


K•E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO MADE IN U.S.A.

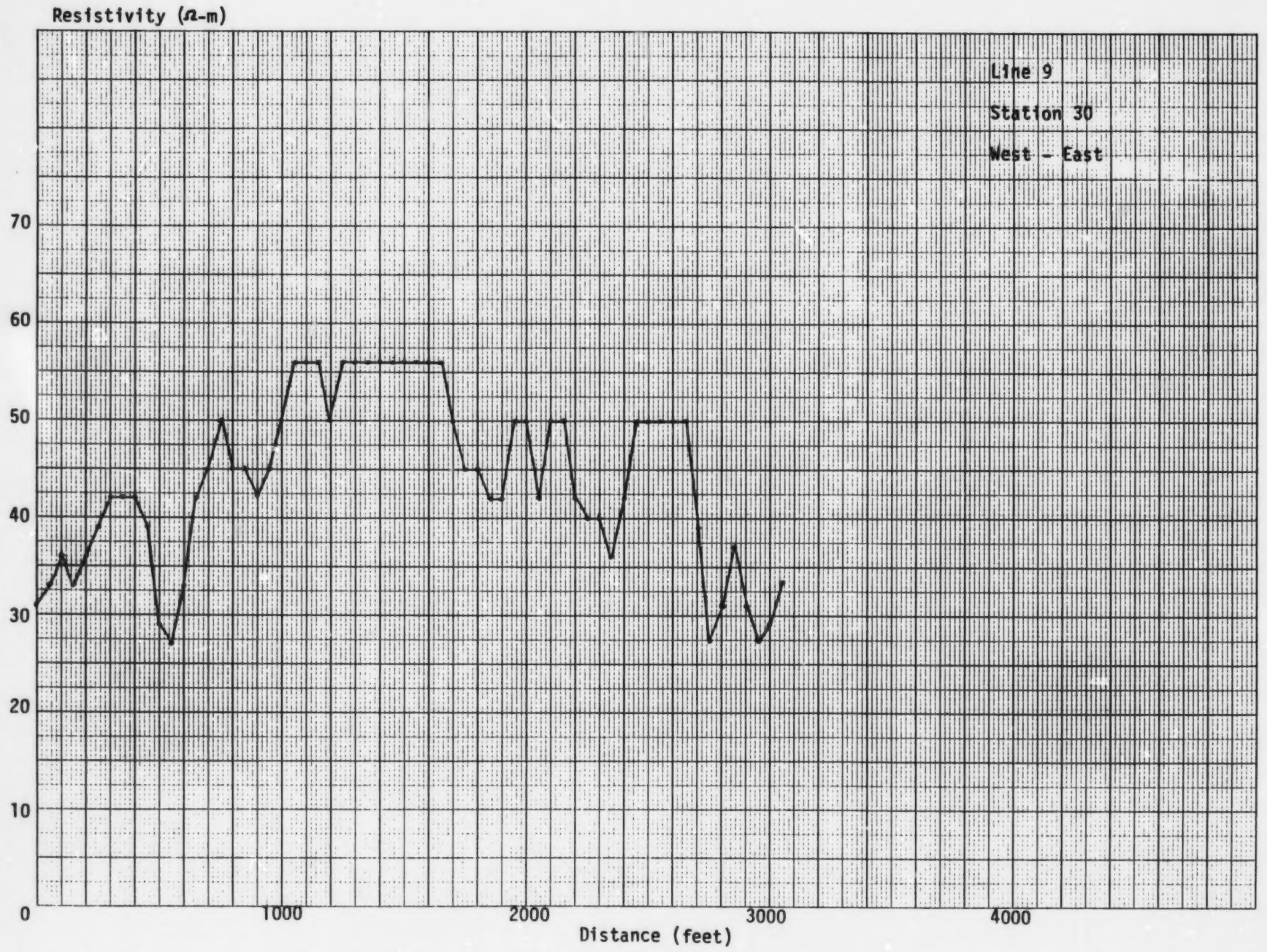
46 1510



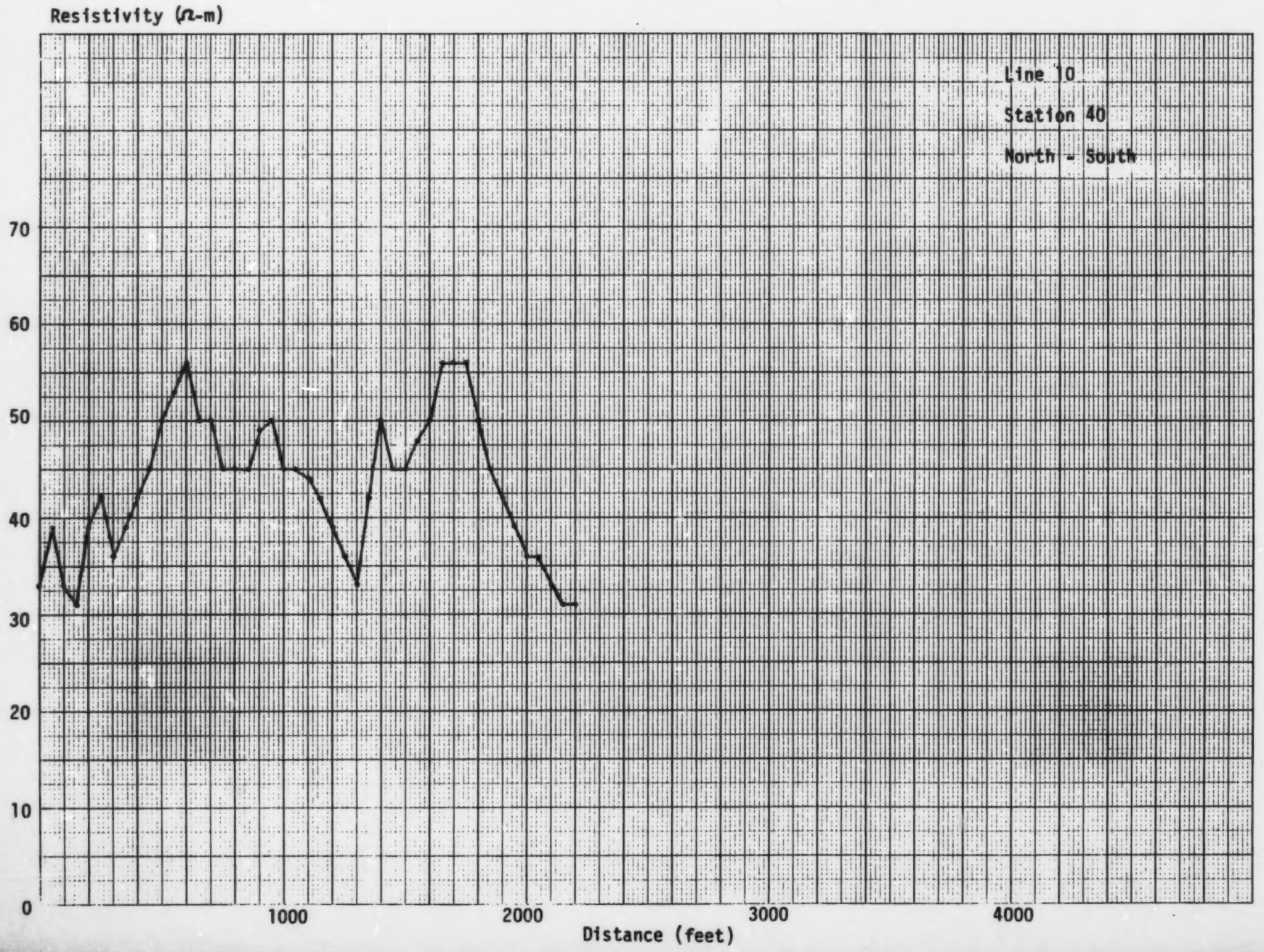
K·E 10 X 10 TO THE CENTIMETER 16 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.



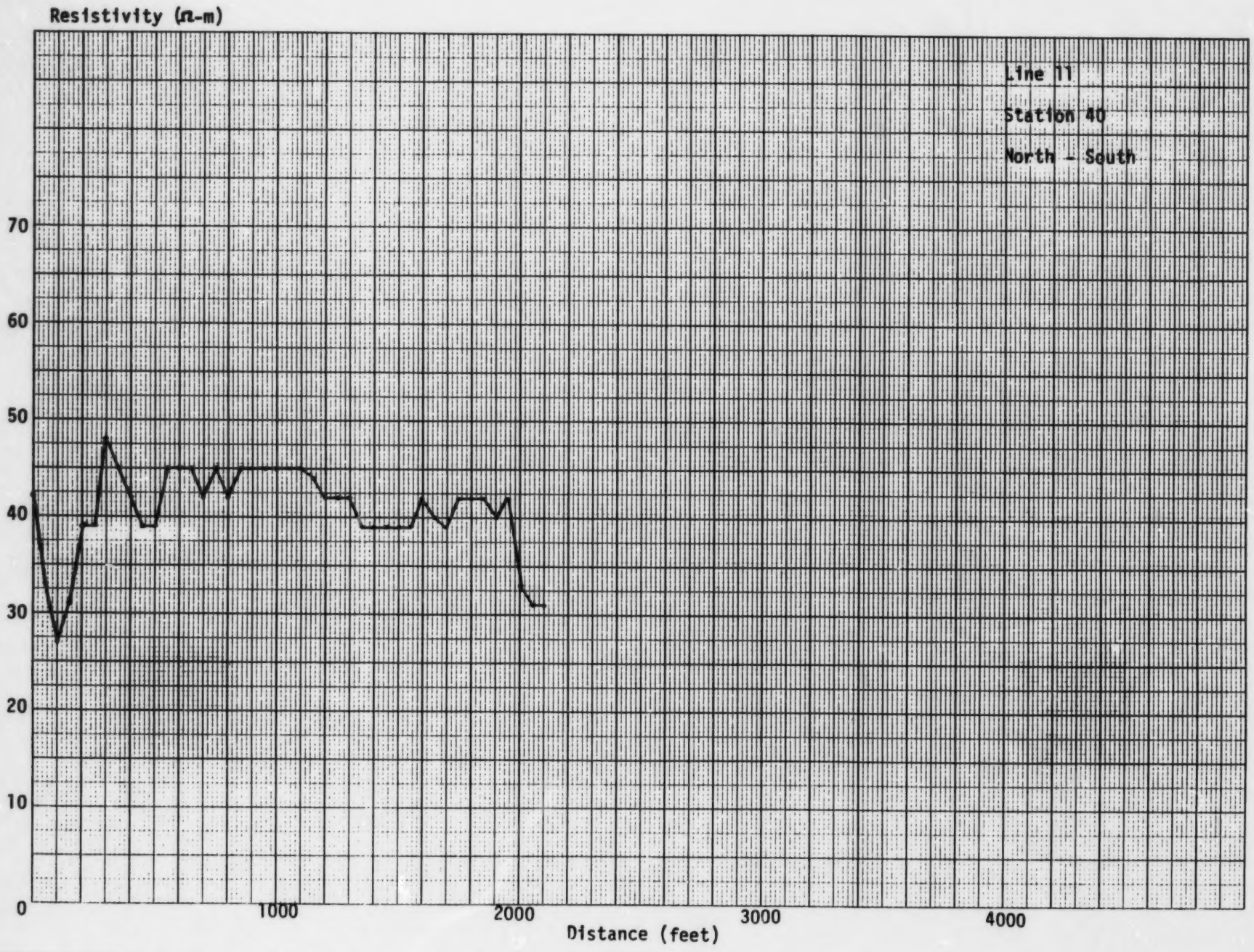
K·E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO MADE IN U.S.A.



K•E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

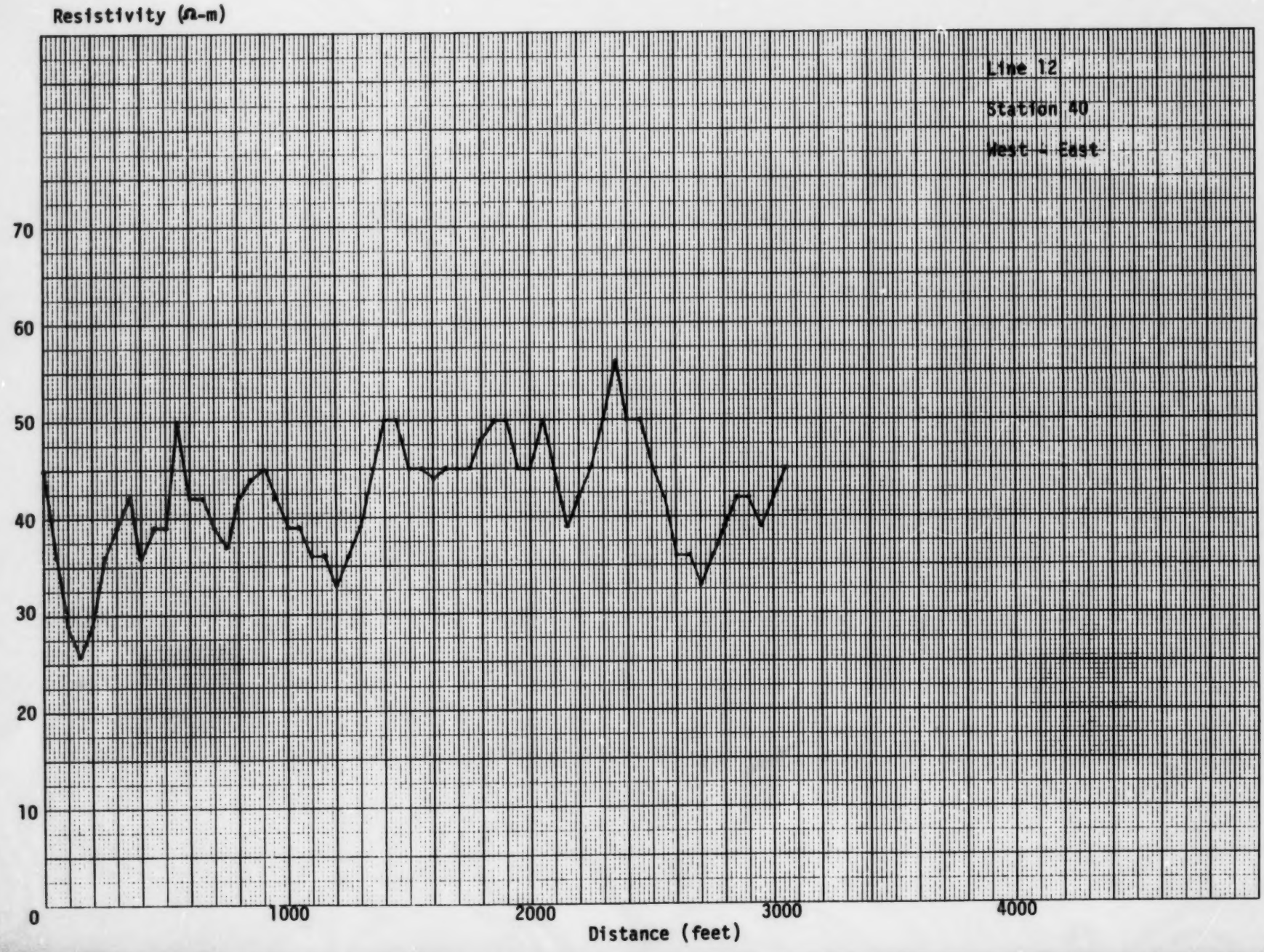


K·E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

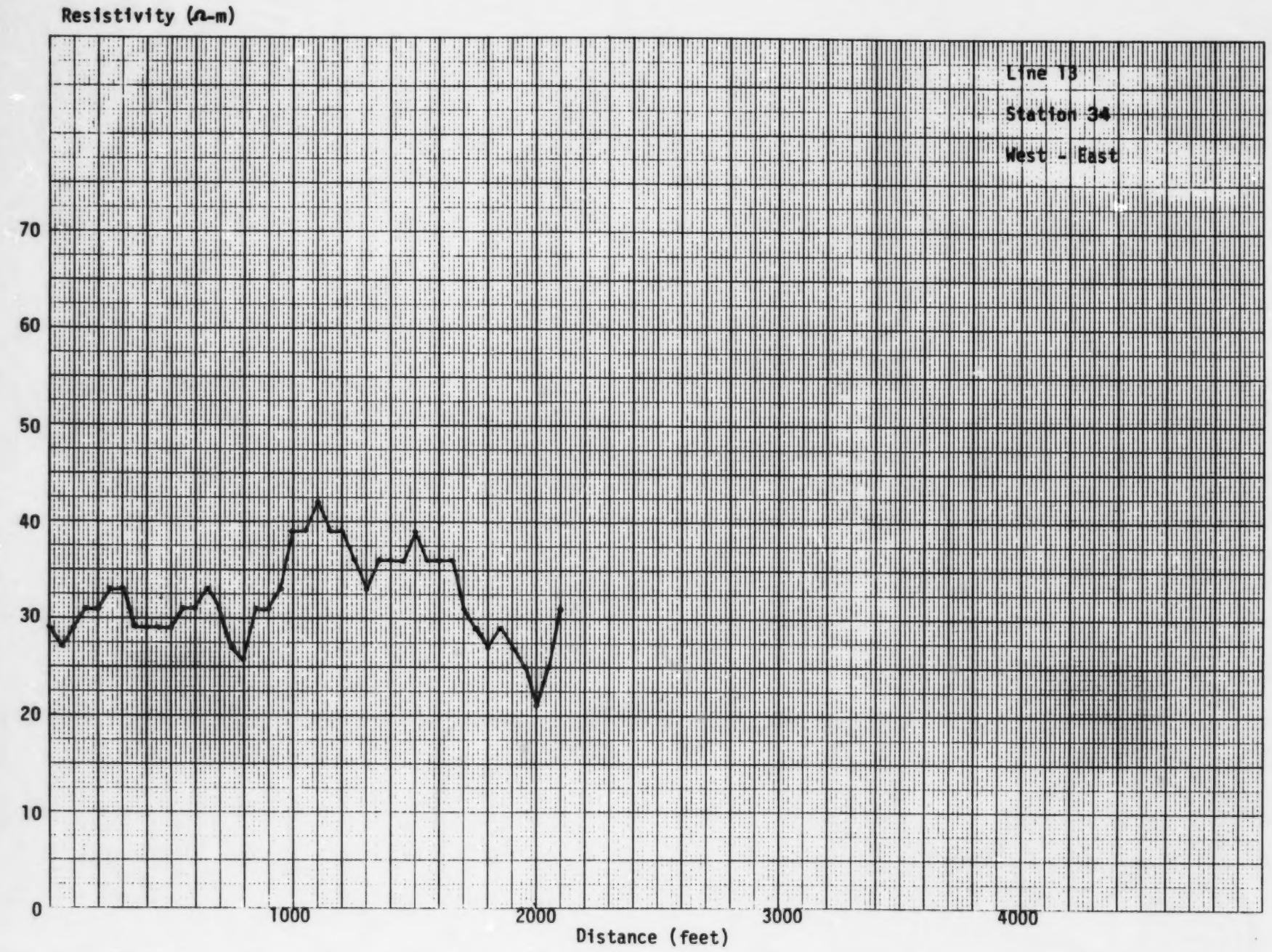


K•E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1510

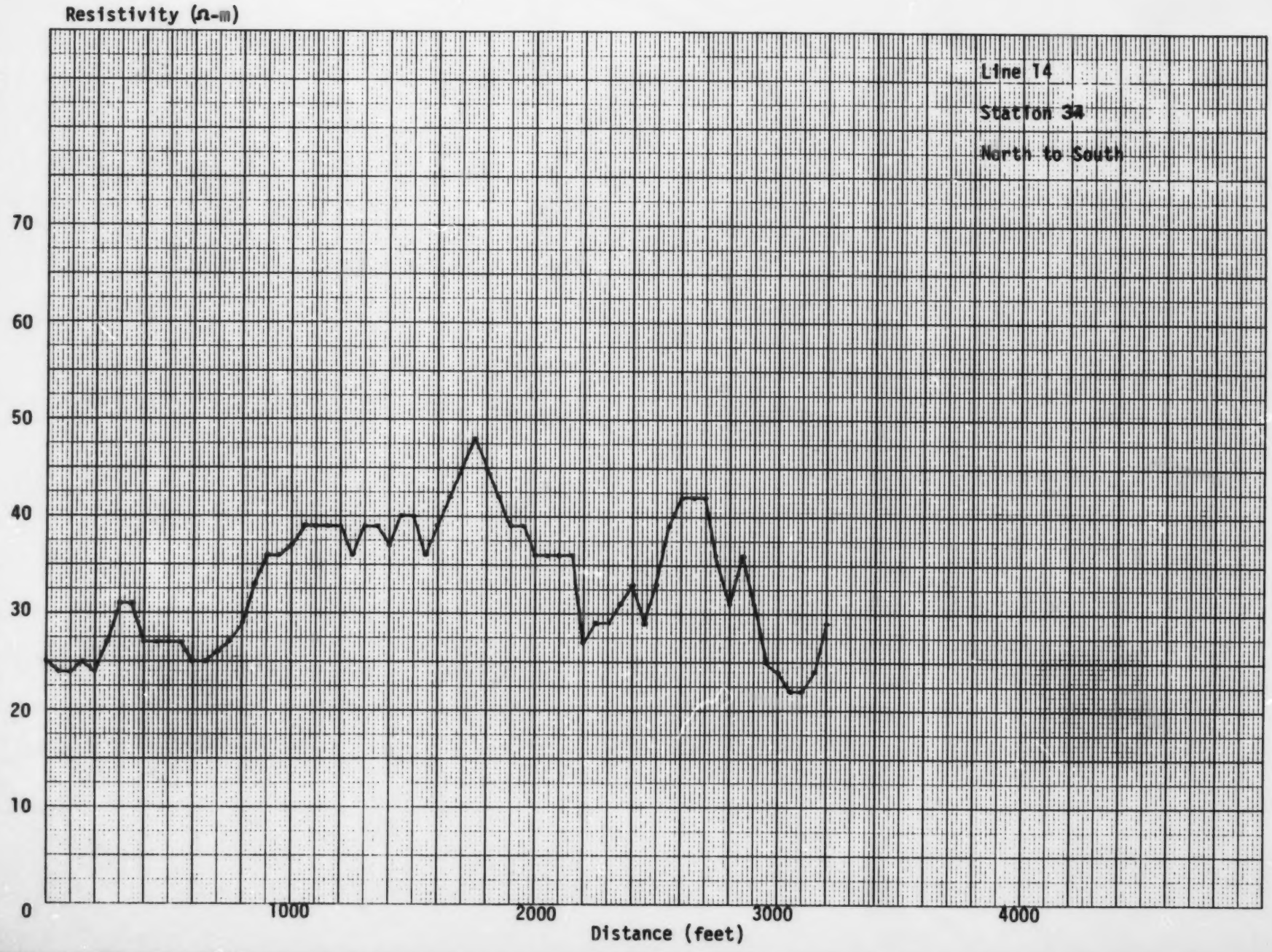


K•E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.



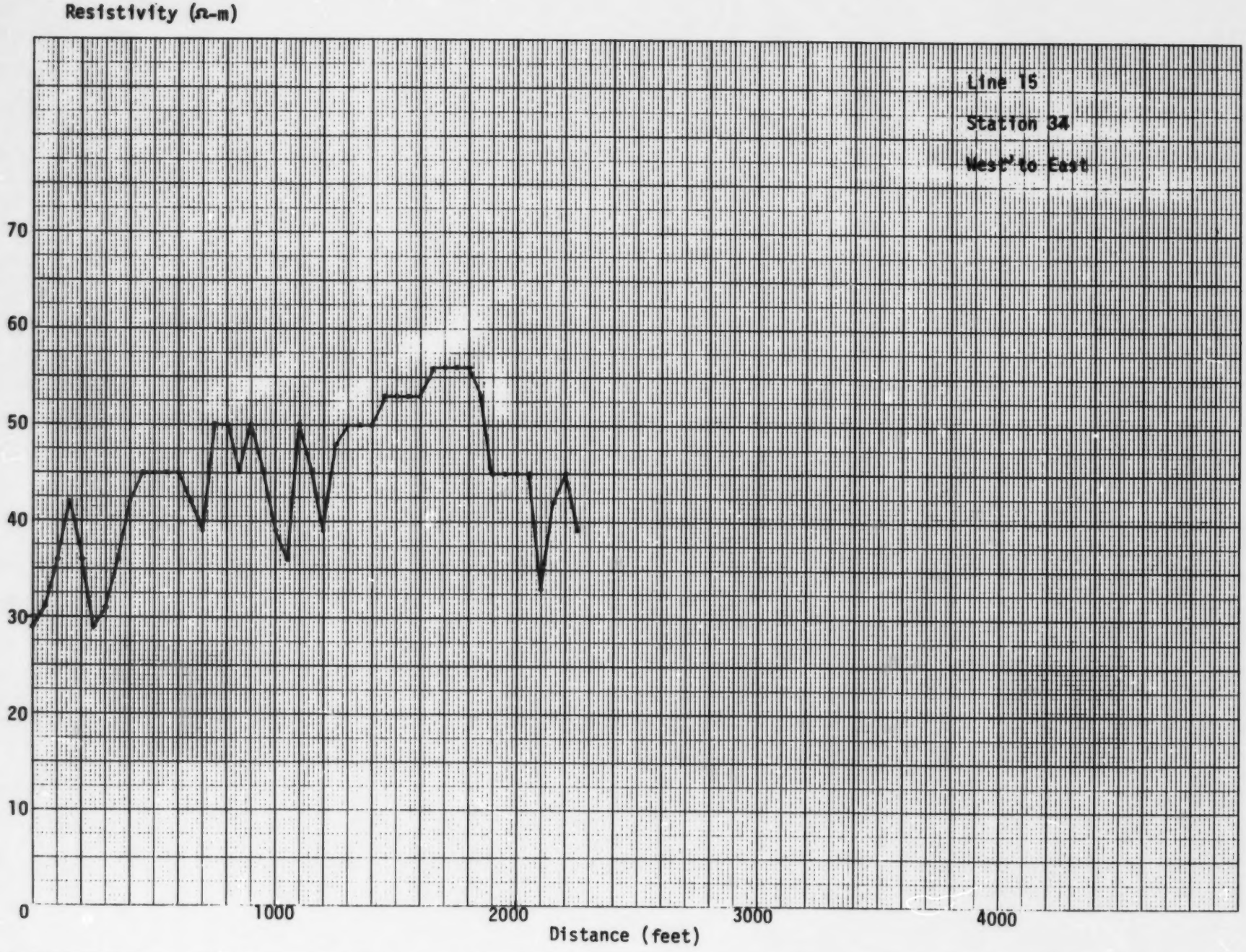
K·E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1510



K·E 10 X 10 TO THE CENTIMETER 16 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1510



APPENDIX B

Summary of Test Pit Logs

TP101	-	0.0	-	0.3 m	Topsoil and organics
		0.3	-	0.6 m	Clay and very fine sand - compacted - massive structure - sharp interface - contains clay lumps
		0.6	-	3.0 m	Fine Sand - friable - massive structure - sharp interface
TP102	-	0.0	-	0.5 m	Topsoil with organics
		0.5	-	1.5 m	Fine to medium sand - friable - horizontal bedding - sharp interface - weak oxidation development
		1.5	-	2.5 m	Medium sand with coarse pebbles - compacted - massive - sharp interface - weak oxidation development - contains shale - 5% - 60% Carbonates - sub-rounded - 35% Crystallines - sub-rounded to sub-angular
		2.5	-	3.0 m	Fine to Medium Sand - friable - massive - sharp interface
TP103	-	0.0	-	0.5 m	Topsoil with organics
		0.5	-	2.0 m	Fine to Medium Sand - friable - horizontal bedding - sharp interface
		2.0	-	2.5 m	Medium sand with coarse pebbles - compacted - massive - sharp interface - weak oxidation development - shale - 5% - 60% Carbonates - sub-rounded - 35% Crystallines - sub-rounded to sub-angular

		2.5	-	3.0 m	Fine to medium sand - compacted - massive - sharp interface
TP104	-	0.0	-	0.7 m	Topsoil with organics
		0.7	-	3.0 m	Fine sand - compacted - massive - contains shale and clay lumps
TP105	-	0.0	-	0.2 m	Topsoil with organics
		0.2	-	0.5 m	Fine to medium sand - friable - massive - sharp interface
		0.5	-	2.0 m	Very coarse sand and pebbles - friable - massive - sharp interface - weak oxidation development - shale 5% - 60% Carbonates - sub-rounded - 35% Crystalline - sub-rounded to sub-angular
		2.0	-	2.5 m	Fine to medium sand - compacted - horizontal bedding - sharp interface
		2.5	-	3.0 m	Very coarse sand and gravel - same as above (0.5 - 2.0)
TP106	-	0.0	-	0.1 m	Topsoil with organics
		0.1	-	3.0 m	Fine to medium sand - friable - massive
TP107	-	0.0	-	0.5 m	Topsoil with organics
		0.5	-	3.0 m	Fine sand and pebbles - friable - massive - clay lumps and shale

TP108	-	0.0	-	0.5 m	Topsoil with organics
		0.5	-	3.0 m	Fine to medium sand - friable - massive - clay lumps
TP109	-	0.0	-	0.4 m	Topsoil with organics
		0.4	-	3.0 m	Fine to medium sand - friable - massive
TP110	-	0.0	-	0.5 m	Topsoil with organics
		0.5	-	1.0 m	Fine to medium sand - friable - massive - sharp interface
		1.0	-	3.0 m	Coarse sand and pebbles - friable - massive - sharp interface - weak oxidation development - some shale - 60% Crystallines - sub-rounded to sub-angular - 40% Carbonates - sub-rounded
TP111	-	0.0	-	0.2 m	Coarse sand and pebbles - friable - massive - sharp interface - weak oxidation development - some shale - 60% Crystallines - sub-rounded to sub-angular - 40% Carbonates - sub-rounded
		0.2	-	0.4 m	Medium sand - compacted - horizontal bedding - sharp interface
		0.4	-	0.9 m	Clay - compacted - massive - sharp interface - clay lumps
		0.9	-	1.9 m	Coarse sand and pebbles - as above

		1.9	-	3.0 m	Fine sand - compacted - massive - sharp interface
TP112	-	0.0	-	0.4 m	Topsoil with organics
		0.4	-	3.0 m	Medium sand with fine pebbles - compacted - massive - shale and clay lumps
TP113	-	0.0	-	0.4 m	Topsoil with organics
		0.4	-	3.0 m	Fine sand - friable - massive
TP114	-	0.0	-	0.6 m	Topsoil with organics
		0.6	-	3.0 m	Fine sand - friable - massive
TP115	-	0.0	-	0.5 m	Topsoil with organics
		0.5	-	2.5 m	Medium sand with coarse pebbles - friable - massive - sharp interface - weak oxidation development - shale - 5% - 50% Carbonates - sub-rounded - 45% Crystallines - sub-angular to sub-rounded
		2.5	-	3.0 m	Fine to medium sand - friable - massive - sharp interface - clay lumps
TP116	-	0.0	-	0.4 m	Topsoil with organics
		0.4	-	3.0 m	Fine sand and pebbles - friable - massive - sharp interface - weak oxidation development - shale 10% - 50% Carbonates - sub-rounded - 40% Crystallines - sub-rounded

TP117	-	0.0	-	0.5 m	Topsoil with organics
		0.5	-	1.5 m	Medium sand - compacted - massive - sharp interface - shale and clay lumps
		1.5	-	1.7 m	Fine sand and clay - compacted - massive - sharp interface - clay lumps
		1.7	-	3.0 m	Fine sand and pebbles - compacted - massive - sharp interface - weak oxidation development - shale - 10% - 50% Carbonates - sub-rounded - 40% Crystallines - sub-rounded
TP118	-	0.0	-	1.3 m	Topsoil with organics
		1.3	-	2.3 m	Fine to medium sand - friable - horizontal bedding - sharp interface
		2.3	-	3.0 m	Coarse sand and pebbles - compacted - massive - sharp interface - weak oxidation development - shale - 60% Carbonates - sub-rounded - 40% Crystallines - sub-rounded to sub-angular
TP119	-	0.0	-	0.6 m	Topsoil with organics
		0.6	-	1.1 m	Fine to medium sand - compacted - graded bedding - sharp interface
		1.1	-	1.6 m	Clay - compacted - massive - sharp interface
		1.6	-	3.0 m	Fine to medium sand - compacted - massive - sharp interface

TP120	-	0.0	-	0.7 m	Topsoil with organics
		0.7	-	1.1 m	Very fine sand and clay - compacted - massive - sharp interface - clay lumps
		1.1	-	3.0 m	Fine to medium sand - friable - massive - sharp interface
TP121	-	0.0	-	0.4 m	Topsoil with organics
		0.4	-	1.1 m	Clay - compacted - massive - sharp interface
		1.1	-	3.0 m	Medium sand with fine pebbles - compacted - massive - sharp interface - some shale - 50% Carbonates - sub-rounded - 50% Crystallines - sub-rounded
TP122	-	0.0	-	0.3 m	Topsoil with organics
		0.3	-	0.8 m	Clay and very fine sand - compacted - massive - sharp interface - clay lumps
		0.8	-	3.0 m	Medium sand and granules - compacted - massive - sharp interface - shale and clay lumps - 50% Carbonates - sub-rounded - 50% Crystallines - sub-rounded
TP123	-	0.0	-	0.7 m	Topsoil with organics
		0.7	-	3.0 m	Fine to medium sand - compacted - massive - clay lumps

TP124	-	0.0	-	0.5 m	Topsoil with organics
		0.5	-	3.0 m	Fine sand - compacted - massive
TP125	-	0.0	-	0.3 m	Topsoil with organics
		0.3	-	0.7 m	Fine sand and clay - compacted - massive - sharp interface - clay lumps
		0.7	-	3.0 m	Fine to medium sand - friable - massive - sharp interface - clay lumps
TP126	-	0.0	-	0.3 m	Topsoil with organics
		0.3	-	3.0 m	Medium sand with coarse pebbles - friable - massive - sharp interface - weak oxidation development - shale 5% - 55% Carbonates - sub-rounded - 40% Crystallines - sub-angular to sub-rounded
TP127	-	0.0	-	0.5 m	Topsoil with organics
		0.5	-	1.0 m	Very fine sand with clay - compacted - massive - sharp interface
		1.0	-	2.0 m	Very coarse sand and pebbles - friable - massive - sharp interface - weak oxidation development - shale 5% - 55% Carbonates - sub-rounded - 40% Crystallines - rounded to sub-angular
		2.0	-	3.0 m	Fine to medium sand - friable - massive - sharp interface

TP128	-	0.0	-	0.3 m	Topsoil with organics
		0.3	-	3.0 m	Fine to medium sand - friable - massive - sharp interface - shale - 65% Carbonates - sub-rounded - 35% Crystallines - sub-rounded
TP129	-	0.0	-	1.0 m	Topsoil with organics
		1.0	-	2.4 m	Medium sand with coarse pebbles - friable - massive - sharp interface - weak oxidation development - shale 20% - 60% Carbonates - sub-rounded - 20% Crystallines - sub-rounded to sub-angular
		2.4	-	2.9 m	Fine sand and pebbles - as above (1.0 - 2.4)
		2.9	-	3.0 m	Clay - compact - massive
TP130	-	0.0	-	0.6 m	Topsoil with organics
		0.6	-	2.0 m	Medium sand and coarse pebbles - friable - massive - sharp interface - weak oxidation development - shale 30% - 40% Carbonates - sub-rounded - 30% Crystallines - sub-rounded to sub-angular
		2.0	-	2.3 m	Clay - compact - massive - sharp interface
		2.3	-	3.0 m	Medium sand with coarse pebbles - as above (0.6 - 2.0)
TP131	-	0.0	-	1.5 m	Medium sand with fine pebbles - compacted - massive - sharp interface - weak oxidation - shale 5% - 70% Carbonates - sub-rounded - 25% Crystallines - sub-angular to sub-rounded

		1.5	-	2.4 m	Clay - massive - compacted
		2.4	-	3.0 m	Medium sand with coarse pebbles - as above (0.0 - 1.5)
TP132	-	0.0	-	0.4 m	Topsoil with organics
		0.4	-	1.2 m	Medium sand with fine pebbles - compacted - massive - sharp interface - shale - 60% Carbonates - sub-rounded - 40% Crystallines - sub-rounded to sub-angular
		1.2	-	1.5 m	Clay and fine sand - compacted - massive - sharp interface
		1.5	-	2.2 m	Medium sand with fine pebbles - as above (0.4 - 1.2)
		2.2	-	3.0 m	Fine to medium sand - compacted - massive - clay lumps
TP133	-	0.0	-	0.3 m	Topsoil with organics
		0.3	-	0.5 m	Coarse sand with fine pebbles - compacted - massive - sharp interface - weak oxidation - shale - 55% Carbonates - sub-rounded - 45% Crystallines - sub-rounded to sub-angular
		0.5	-	1.7 m	Fine to medium sand - friable - massive - sharp interface - shale and clay lumps
		1.7	-	3.0 m	Medium sand and granules - as above (0.3 - 0.5)

TP134	-	0.0	-	2.0 m	Clay till
		2.0	-	2.2 m	Broken shale and till
TP135	-	0.0	-	2.5 m	Clay till
		2.5	-	2.6 m	Broken shale and till
TP136	-	0.0	-	0.3 m	Topsoil
		0.3	-	0.5 m	Pebbles
		0.5	-	2.0 m	Clay till
		2.0	-	2.2 m	Shale till
TP137	-	0.0	-	1.3 m	Clay till
		1.3	-	1.4 m	Broken shale till
TP138	-	0.0	-	2.3 m	Clay till
		2.3	-	2.4 m	Shale
TP139	-	0.0	-	2.3 m	Clay till
		2.3	-	2.4 m	Shale till
TP140	-	0.0	-	2.0 m	Clay
		2.0	-	2.2 m	Shale and till
TP141	-	0.0	-	2.0 m	Clay till
		2.0	-	2.1 m	Shale
TP142	-	0.0	-	2.3 m	Clay till
		2.3	-	2.5 m	Shale and till
TP143	-	0.0	-	3.0 m	Clay till

APPENDIX C

Computer Forms

FORM 1

SAND & GRAVEL INVENTORY

DEPOSIT STATUS

DEPOSIT NO: ⌊⌋⌊⌋⌊⌋⌊⌋⌊⌋⌊⌋⌊⌋ ⌊⌋ SUB

LANDFORM ⌊⌋ (if K specify landform under depcom field)

DEPOSIT COMMENTS ⌊⌋⌊⌋⌊⌋⌊⌋⌊⌋⌊⌋⌊⌋

Sand and Gravel Inventory

Exposure — Stratigraphic Section Data

Form 2

DEPOSIT NO. SUB

TOWNSHIP RANGE SECTION 1/4 SECTION

EXPOSURE NO.

EXPOSURE TYPE

EXP. LAND USE

SUR. LAND USE

THICKNESS OF ECONOMIC UNIT (m)

ESTIMATED GRAVEL CONTENT

Y M D
DATE EXAMINED

MATERIAL DESCRIPTION

COMMENTS

STRATIGRAPHIC SECTION

GEOLOGIST

HEIGHT OF SECTION

HEIGHT EXAMINED

DEPTH TO WATER TABLE (m)

MATERIAL AT BASE OF SECTION

% LITHOLOGY % LITHOLOGY

PRIMARY SECONDARY
GROSS LITHOLOGY

PRIMARY SECONDARY CHANNEL SAMPLE (Y, N)
DELETERIOUS SUBSTANCES

CHECK
MATERIAL LARGER THAN 15CM AVAILABLE BUT NOT SAMPLED

STRATIGRAPHIC SECTION

GEOLOGIST

HEIGHT OF SECTION

HEIGHT EXAMINED

DEPTH TO WATER TABLE (m)

MATERIAL AT BASE OF SECTION

% LITHOLOGY % LITHOLOGY

PRIMARY SECONDARY
GROSS LITHOLOGY

PRIMARY SECONDARY CHANNEL SAMPLE (Y, N)
DELETERIOUS SUBSTANCES

CHECK
MATERIAL LARGER THAN 15CM AVAILABLE BUT NOT SAMPLED

SIEVE ANALYSIS

FORM 3

DEPOSIT NO. SUB TWP. RNG. SCT. ¼ SCT. EXPOSURE STRAT. SCT.

SAMPLE NO.

COMMENT

WEIGHT OF FINE FRACTION _____ GMS. CRUSHABLE MATERIAL ☐ (1 = YES, 0 = NO)

WEIGHT BEFORE WASHING _____ GMS. WEIGHT AFTER WASHING _____ GMS.

Screen	mm	phi units	Weight on Sieve (Gms.)	
4"	101.6	-6.65		
3½"	88.9	-6.47		
3"	76.2	-6.25		
2½"	63.5	-6.00		
2"	50.8	-5.67		
1½"	38.1	-5.25		
1"	25.4	-4.67		COARSE FRACTION
3/4"	19.1	-4.25		
5/8"	15.9	-4.00		
1/2"	12.7	-3.67		
3/8"	9.5	-3.25		
1/4"	6.35	-2.67		
#4	4.76	-2.25		
#8	2.38	-1.25		
#10	2.00	-1.00		
#16	1.19	-0.25		
#30	0.59	+0.75		
#40	0.42	+1.25		FINE FRACTION
#50	0.30	+1.75		
#80	0.177	+2.50		
#100	0.149	+2.75		
#200	0.074	+3.75		
< 200				

MG-9466

APPENDIX D

Example of Computer Printout

DEPOSIT RETRIEVAL - DEPOSITS 007200 TO 007210

********** DEPOSIT NUMBER 007200 LANDFORM - ----------FLOODPLAIN DEPOSIT

009 10W 06 NW RESERVES 700,000 CU.M. AMOUNT DEPLETED/NOT AVAILABLE 0 CU.M.
OWNERSHIP PRIVATE

EXPOSURE TP101 BACKHOE TEST PIT ECON.THICKNESS 2.5 M. GRAVEL CONTENT LOW FIRST VISIT 84/10
MATERIAL FINE TO MEDIUM SAND WITH SOME GRAVEL LAST VISIT 84/10
EXP.LAND USE AGRICULTURE SUR.LAND USE AGRICULTURE

SECTION A GEOLOGIST LB HT. EXAMINED 2.5 M. HT. OF FACE 3.0 M. DEPTH TO WATER TABLE M.
LITHOLOGY 60% GENERAL CARBONATES 35% PRECAMBRIAN CRYSTALLINES
DELETERIOUS SUBSTANCES SHALE CLAY LUMPS
BASE SAND NO CHANNEL SAMPLE TAKEN

EXPOSURE TP102 BACKHOE TEST PIT ECON.THICKNESS 2.5 M. GRAVEL CONTENT MEDIUM LOW FIRST VISIT 84/10
MATERIAL MEDIUM SAND AND GRAVEL LAST VISIT 84/10
EXP.LAND USE AGRICULTURE SUR.LAND USE AGRICULTURE

SECTION A GEOLOGIST LB HT. EXAMINED 2.5 M. HT. OF FACE 3.0 M. DEPTH TO WATER TABLE M.
LITHOLOGY 60% GENERAL CARBONATES 35% PRECAMBRIAN CRYSTALLINES
DELETERIOUS SUBSTANCES SHALE CLAY LUMPS
BASE SAND CHANNEL SAMPLE TAKEN

SAMPLE-- COBBLES 0.0 % PEBBLES 35.28 % GRANULES 21.37 % SAND 40.41 % SILT/CLAY 2.94 %

009 10W 07 SW RESERVES 700,000 CU.M. AMOUNT DEPLETED/NOT AVAILABLE 0 CU.M.
OWNERSHIP PRIVATE

EXPOSURE TP104 BACKHOE TEST PIT ECON.THICKNESS 2.5 M. GRAVEL CONTENT LOW FIRST VISIT 84/10
MATERIAL FINE SAND LAST VISIT 84/10
EXP.LAND USE AGRICULTURE SUR.LAND USE AGRICULTURE

SECTION A GEOLOGIST LB HT. EXAMINED 2.5 M. HT. OF FACE 3.0 M. DEPTH TO WATER TABLE M.
LITHOLOGY 60% GENERAL CARBONATES 35% PRECAMBRIAN CRYSTALLINES
DELETERIOUS SUBSTANCES SHALE CLAY LUMPS
BASE SAND CHANNEL SAMPLE TAKEN

SAMPLE-- COBBLES 0.0 % PEBBLES 0.0 % GRANULES 0.0 % SAND 95.87 % SILT/CLAY 4.13 %

009 11W 01 NE RESERVES 115,000 CU.M. AMOUNT DEPLETED/NOT AVAILABLE 0 CU.M.
OWNERSHIP PRIVATE

EXPOSURE TP103 BACKHOE TEST PIT ECON.THICKNESS 2.5 M. GRAVEL CONTENT LOW FIRST VISIT 84/10
MATERIAL MEDIUM SAND WITH SOME GRAVEL LAST VISIT 84/10
EXP.LAND USE AGRICULTURE SUR.LAND USE AGRICULTURE

SECTION A GEOLOGIST LB HT. EXAMINED 2.5 M. HT. OF FACE 3.0 M. DEPTH TO WATER TABLE M.
LITHOLOGY 60% GENERAL CARBONATES 35% PRECAMBRIAN CRYSTALLINES
DELETERIOUS SUBSTANCES SHALE
BASE SAND NO CHANNEL SAMPLE TAKEN

SAMPLE IDENTIFICATION 010100 009-10W-06NW TP102A

AVAILABILITY OF CRUSHABLE MATERIAL ON SITE - NONE

WEIGHT OF SAND 23646.20 GMS. WASHED SAMPLE - WEIGHT BEFORE 774.00 AFTER 751.50 % LOSS 2.91

SIEVE SIZE	FINE FRACTION (GMS.)	SIEVE WEIGHTS (GMS.)	PERCENT	PERCENT PASSING	PERCENT RETAINED
4 IN		0.0	0.0	100.00	0.0
3 1/2 IN		0.0	0.0	100.00	0.0
3 IN		0.0	0.0	100.00	0.0
2 1/2 IN		0.0	0.0	100.00	0.0
2 IN		227.30	0.86	99.14	0.86
1 1/2 IN		312.10	1.19	97.95	2.05
1 IN		897.70	3.41	94.54	5.46
3/4 IN		1220.20	4.64	89.90	10.10
5/8 IN	21.90	669.06	2.54	87.35	12.65
1/2 IN	16.00	488.81	1.86	85.50	14.50
3/8 IN	59.00	1802.49	6.85	78.64	21.36
1/4 IN	81.90	2502.10	9.51	69.13	30.87
# 4	38.00	1160.92	4.41	64.72	35.28
# 8	155.00	4735.35	18.00	46.71	53.29
# 10	29.00	885.97	3.37	43.35	56.65
# 16	93.00	2841.21	10.80	32.54	67.46
# 30	155.90	4762.84	18.11	14.44	85.56
# 40	32.00	977.62	3.72	10.72	89.28
# 50	23.50	717.94	2.73	7.99	92.01
# 80	28.00	855.42	3.25	4.74	95.26
# 100	6.00	183.30	0.70	4.04	95.96
# 200	9.50	290.23	1.10	2.94	97.06
<200 + W	25.30	772.93	2.94	0.0	100.00
TOTALS	774.00	26303.47			

SPLITTING FACTOR 30.55

FINENESS MODULUS 4.63

% COBBLES 0.0 % PEBBLES 35.28 % GRANULES 21.37 % SAND 40.41 % SILT/CLAY 2.94

APPENDIX E

SUMMARY OF DEPOSIT DATA

SUMMARY OF COMPUTER PRINT OUT DATA

Gravel	-	2 mm
Sand	-	0.074 mm - 2mm
Silt/Clay	-	0.074 mm

Lithology

C	-	General Carbonates
X	-	General Crystalline

Gravel Content

H	-	75% Gravel
M	-	50 - 75% Gravel
ML	-	25 - 50% Gravel
L	-	25% Gravel

DEPOSIT NUMBER	EXPOSURE NUMBER	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT/CLAY	GRAVEL CONTENT	LITHOLOGY	OWNERSHIP	RESERVES (CUBIC METRES)
7200	TP 101	-	-	-	L	60 C 35 X	Private	1,630,000
	TP 102	56.95	40.41	2.94	M	60 C 35 X		
	TP 103	-	-	-	L	60 C 35 X		
	TP 104	-	95.87	4.13	L	60 C 35 X		
7201 A	TP 105	71.77	26.97	1.26	M	60 C 35 X	Private	18,750
7201 B	TP 106	-	-	-	L	-	Private	2,841,000
7202	TP 107	1.65	84.92	13.43	L	65 C 35 X	Private	3,055,000
	TP 108	-	-	-	L	-		
	TP 109	-	-	-	L	-		
7203 A	TP 110	-	-	-	M	60 X 40 C	Crown (Provincial)	20,250
	TP 111	64.77	34.53	0.70	M	60 X 40 C		
7203 B	TP 112	1.19	56.45	42.36	L	75 X 25 C	Private	1,660,000

DEPOSIT NUMBER	EXPOSURE NUMBER	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT/CLAY	GRAVEL CONTENT	LITHOLOGY	OWNERSHIP	RESERVES (CUBIC METRES)
	TP 113	-	-	-	L	-		
	TP 114	-	-	-	L	-		
7204 A	TP 115	76.48	22.09	1.44	H	50 C 45 X	Private	40,000
7204 B	TP 116	-	-	-	L	50 C 45 X	Private	1,549,000
	TP 117	-	-	-	L	50 C 45 X		
7205 A	TP 118	33.99	62.00	4.01	ML	60 C 40 X	Crown (Municipal)	15,000
7205 B	TP 119	-	-	-	L	-	Private	1,998,000
	TP 120	-	92.06	7.94	L	-		
	TP 121	-	-	-	L	50 C 50 X		
	TP 122	0.65	96.76	2.58	L	50 C 50 X		
7206 A	TP 126	38.99	47.86	13.15	ML	55 C 40 X	Crown (Provincial)	31,250
7206 B	TP 123	-	87.89	12.11	L	-	Private	2,227,500
	TP 124	-	-	-	L	-		

DEPOSIT NUMBER	EXPOSURE NUMBER	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT/CLAY	GRAVEL CONTENT	LITHOLOGY	OWNERSHIP	RESERVES (CUBIC METRES)
	TP 125	-	-	-	L	-		
	TP 127	42.99	51.19	5.81	ML	55 C 40 X		
	TP 128	13.36	85.50	1.14	L	65 C 35 X		
7207	TP 130	49.01	45.81	5.18	ML	40 C 30 X	Private	16,000
7208	TP 129	69.68	25.75	4.57	M	60 C 20 X	Private	16,000
7209	TP 131	69.14	22.61	8.25	M	70 C 25 X	Private	322,500
	TP 132	9.29	75.18	15.53	L	60 C 40 X		

VICTORIA RURAL MUNICIPALITY

VICTORIA RURAL MUNICIPALITY

PARK

Twp. 9

7203 A

7203 B

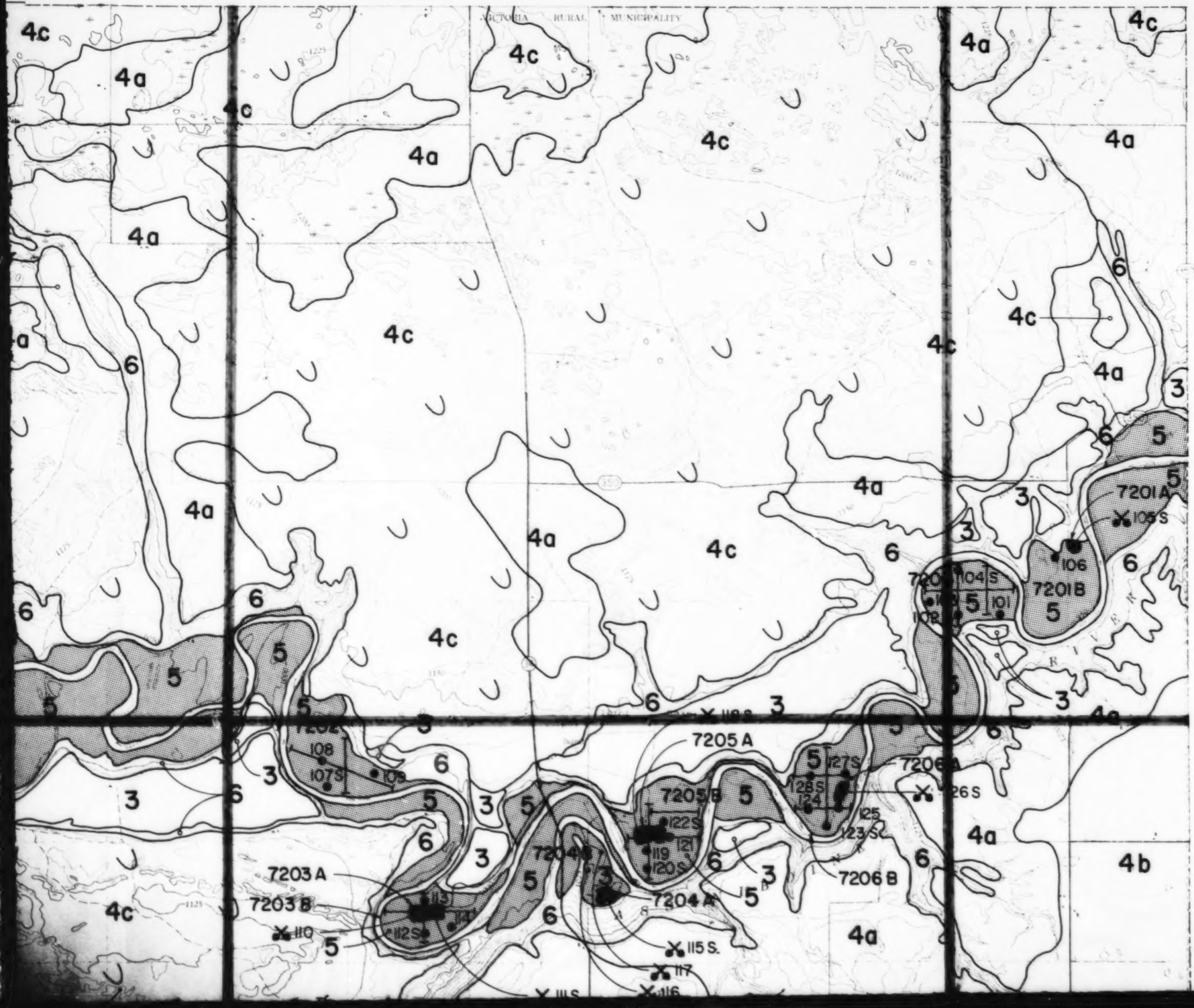
7204 A

7205 A

7206 A

7206 B

7201 B



LEGEND

Quaternary

Recent

6 ..... COL

5 ..... ALL

Post Glacial

4c ..... EOL

4b ..... OFF

4a ..... LIT

3 ..... FLU

Glacial

2b ..... TIL

2a ..... TIL

Cretaceous

1c ..... RID

1b ..... VER

1a ..... FAV

Symbols

..... Geo

7205 ..... Agg

115 S ..... Pit

116 ..... Pit

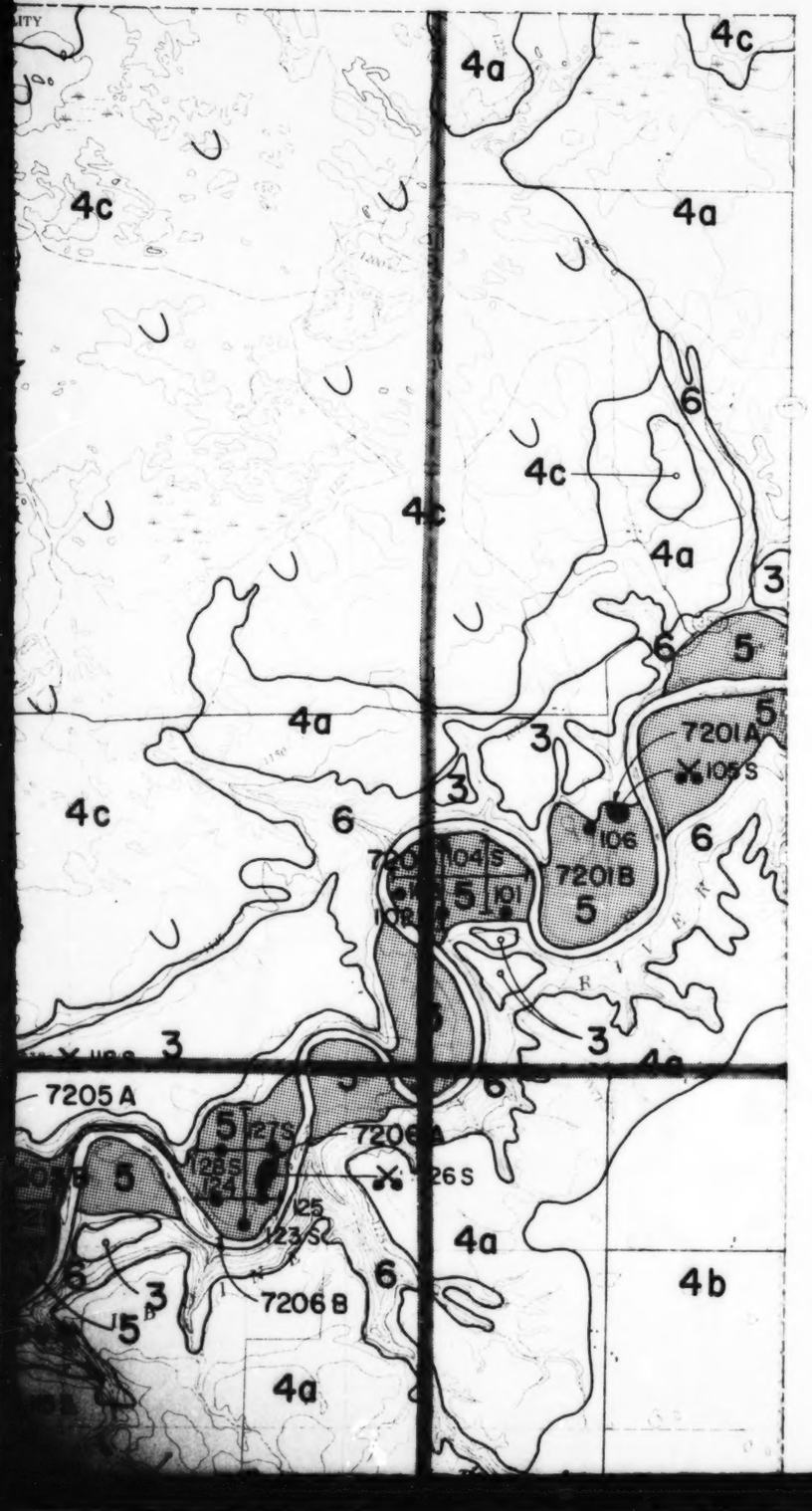
102 S ..... Fie

103 ..... Fie

..... San

..... Min

..... Mel



LEGEND

Quaternary

Recent

6 ..... COLLUVIUM - slumped material on valley slopes, sand and silt, minor clay

5 ..... ALLUVIUM - fine to medium sand, minor silt, clay and organics, localized gravel

Post Glacial

4c ..... EOLIAN DEPOSITS - fine to medium sand, duned, derived from littoral and nearshore deposits

4b ..... OFFSHORE DEPOSITS - sandy silt occasionally interbedded with clay

4a ..... LITTORAL AND NEARSHORE DEPOSITS - silty sand, minor clay

3 ..... FLUVIO - LACUSTRINE DEPOSITS - terraced clay and silt

Glacial

2b ..... TILL PLAIN - grey calcareous silty clay, < 5% stone, < 5m local relief

2a ..... TILL MORAINE - grey calcareous silty clay, >5% stone, >5m local relief, isolated outwash deposits

Cretaceous

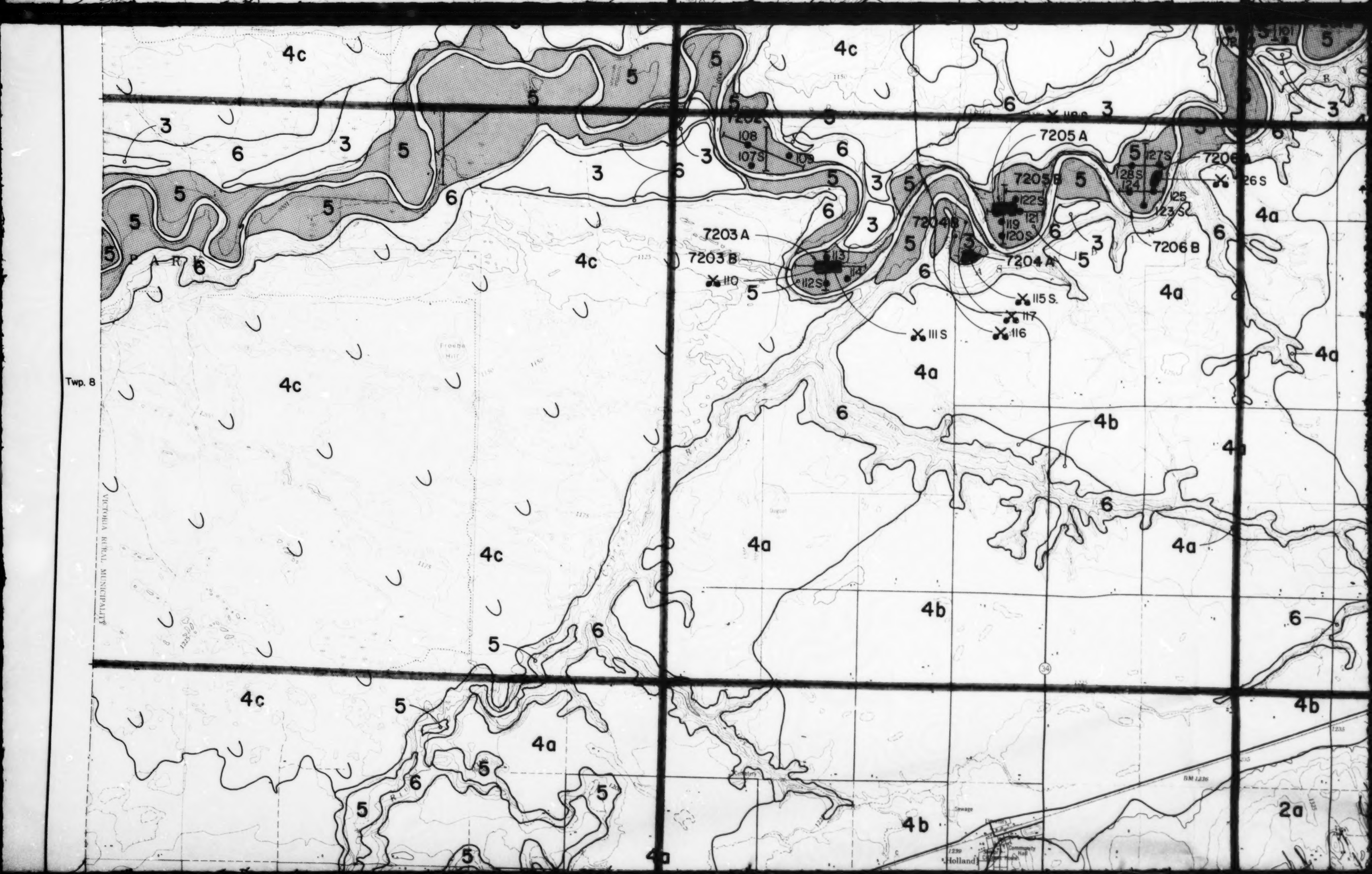
1c ..... RIDING MOUNTAIN FORMATION - hard, siliceous grey shale

1b ..... VERMILION RIVER FORMATION - various grey to black shale beds, both calcareous and non-calcareous with a series of bentonite beds

1a ..... FAVEL FORMATION - grey shale speckled with white calcareous material

Symbols

~~~ ..... Geological Boundary

7205 ..... Aggregate Deposit Number

✕115 S ..... Pit, exposure number, sample *

✕ 116 ..... Pit, exposure number, no sample *

●102 S ..... Field Station, exposure number, sample *

● 103 ..... Field Station, exposure number, no sample *

..... Sand Dunes, wind direction inferred

..... Minor Till Ridges

..... Meltwater Channel
~~~


4c
5
3
6
7205 A
7205 B
7206 A
7206 B
7204 A
7204 B
7203 A
7203 B
108
107 S
109
110
112 S
119
120 S
121
122 S
123 S
124
125
126 S
127 S
128 S
111 S
115 S
116
117
4a
4b
4c
Twp. 8
PARK
Florida Hill
Holland
Community Hall
Sewage
BM 1236
1239
1235
VICTORIA RURAL MUNICIPALITY

1a

Symbols

7205

115 S

116

102 S

103

Aggregate De

Me

Lo

Note:

Gra

7205 A

7205 B

7206 A

7206 B

7204 A

7204 B

7203 A

7203 B

108

107 S

109

110

111 S

112 S

113

114

115 S.

116

117

118 S

119

120 S

121

122 S

123 S

124

125

126 S

127 S

128 S

4a

4b

4c

5

6

Holland

PACIFIC

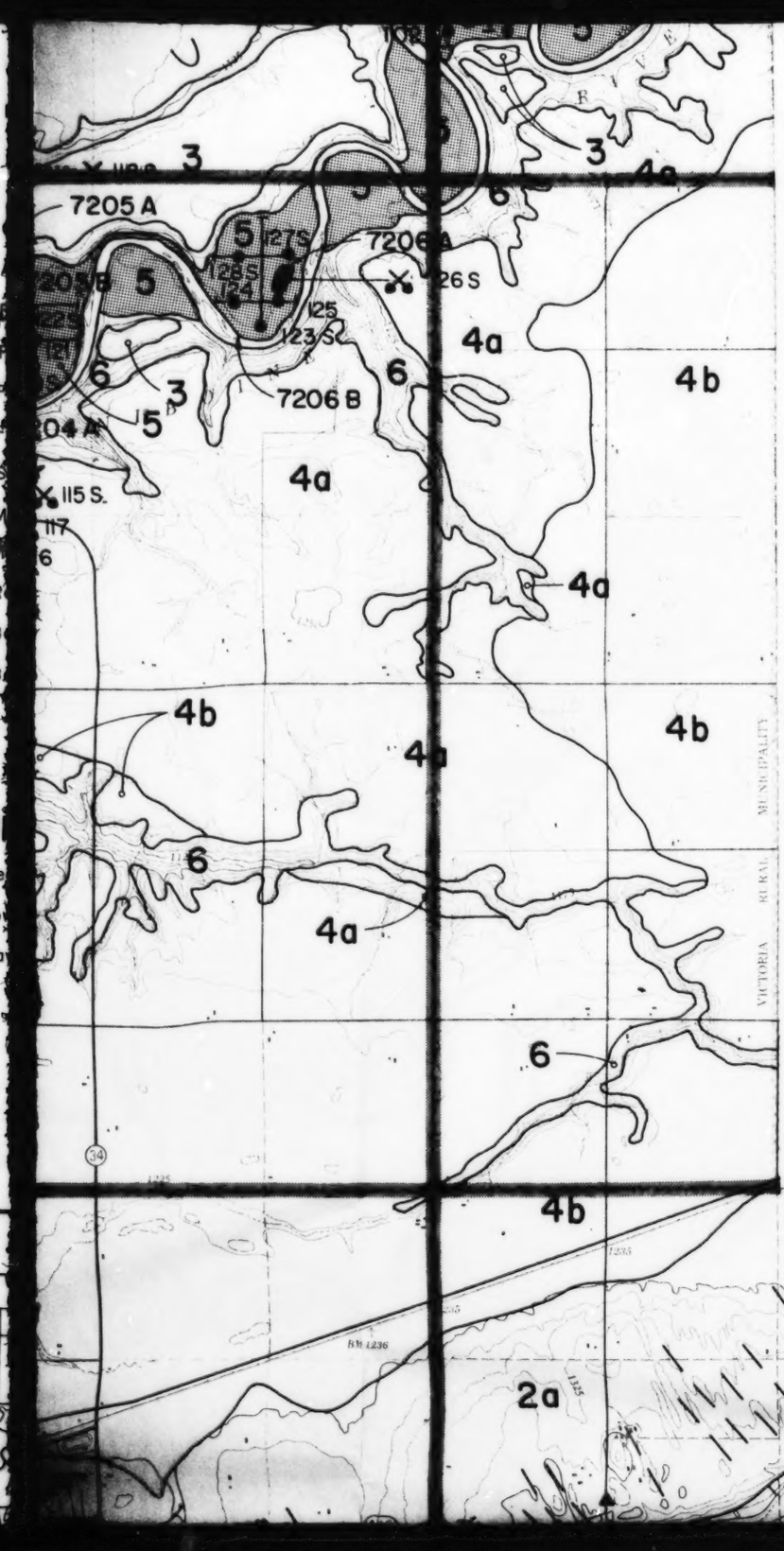
BM 1241

BM 1236

2a

2b

VICTORIA RURAL MUNICIPALITY



both calcareous and non-calcareous with a series of bentonite beds

1a ..... FAVEL FORMATION - grey shale speckled with white calcareous material

Symbols

- Geological Boundary
- 7205 ..... Aggregate Deposit Number
- 115 S ..... Pit, exposure number, sample *
- 116 ..... Pit, exposure number, no sample *
- 102 S ..... Field Station, exposure number, sample *
- 103 ..... Field Station, exposure number, no sample *
- Sand Dunes, wind direction inferred
- Minor Till Ridges
- Meltwater Channel
- Resistivity Line
- Bedrock Outcrop
- Bedrock Quarry

* Exposure numbers are preceded by the letters TP in the report

Aggregate Deposits

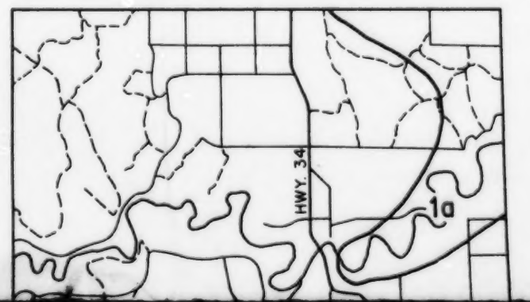
- Medium to High Quality - >25% Gravel Content
- Low Quality - < 25% Gravel Content

Note: Gravel is classified as material greater than 2mm

Scale 1 : 50000

0 0.25 0.5 1.0 2.0 Miles

0 0.5 1.0 2.0 3.0 Kilometres



BEDROCK GEOLOGY MAP

(FROM HALSTEAD, 1959)

CRETACEOUS

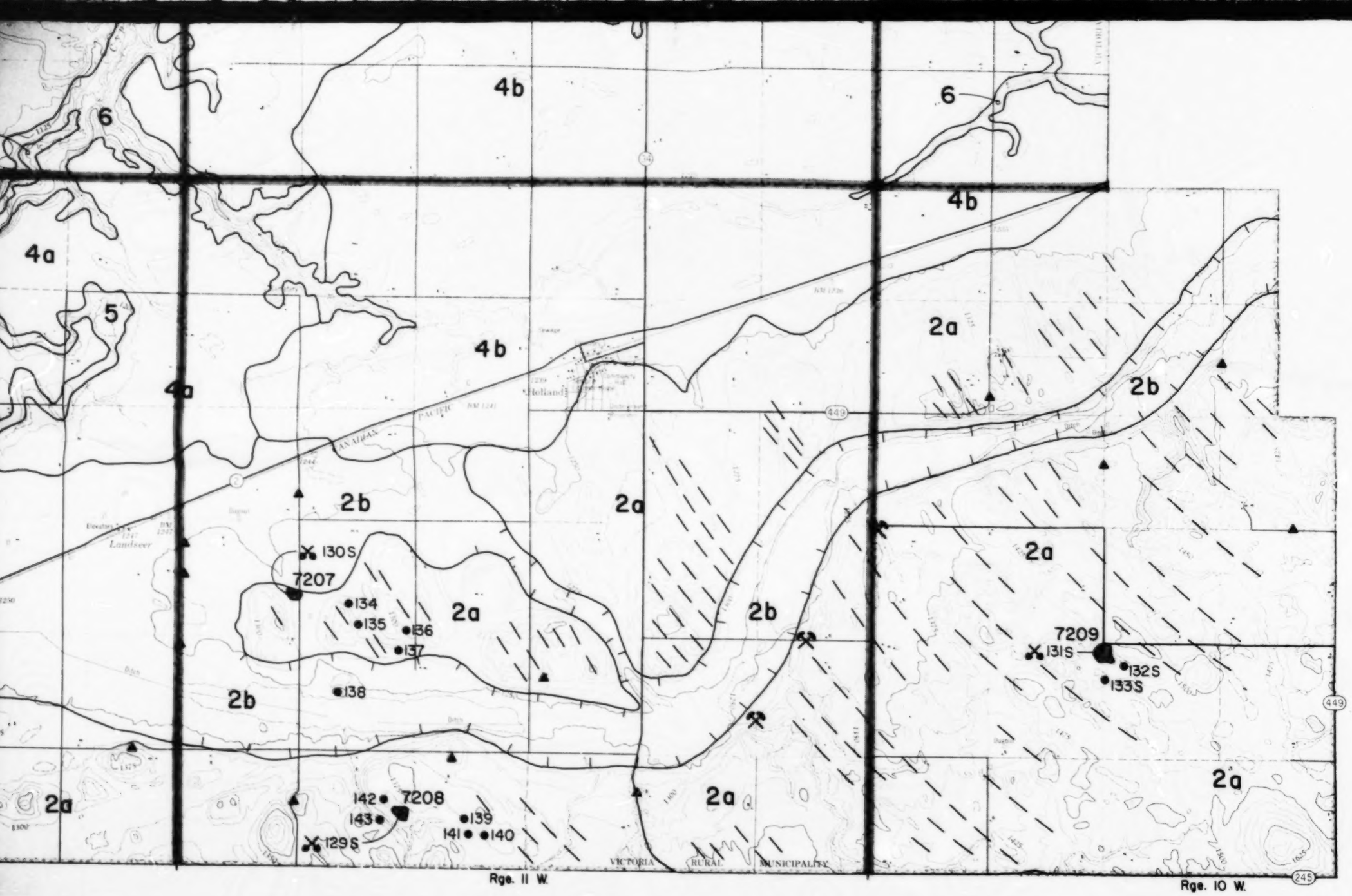
1c ..... RIDING MOUNTAIN FORMATION

1b ..... VERMILION RIVER FORMATION

Twp. 7

4c
4b
4a
2b
2a
5
6
4c
4b
4a
4b
2a
5
6
5
5
5
5
6
5
4a
2b
6
5
Cypress River
5
2b
2b
2a
2b
2a
2a
130S
7207
134
135
136
137
138
142
7208
143
139
141
140
129S
VICTORIA RURAL MUNICIPALITY
VICTORIA RURAL MUNICIPALITY
Rge. 12 W.
Rge. 11 W.

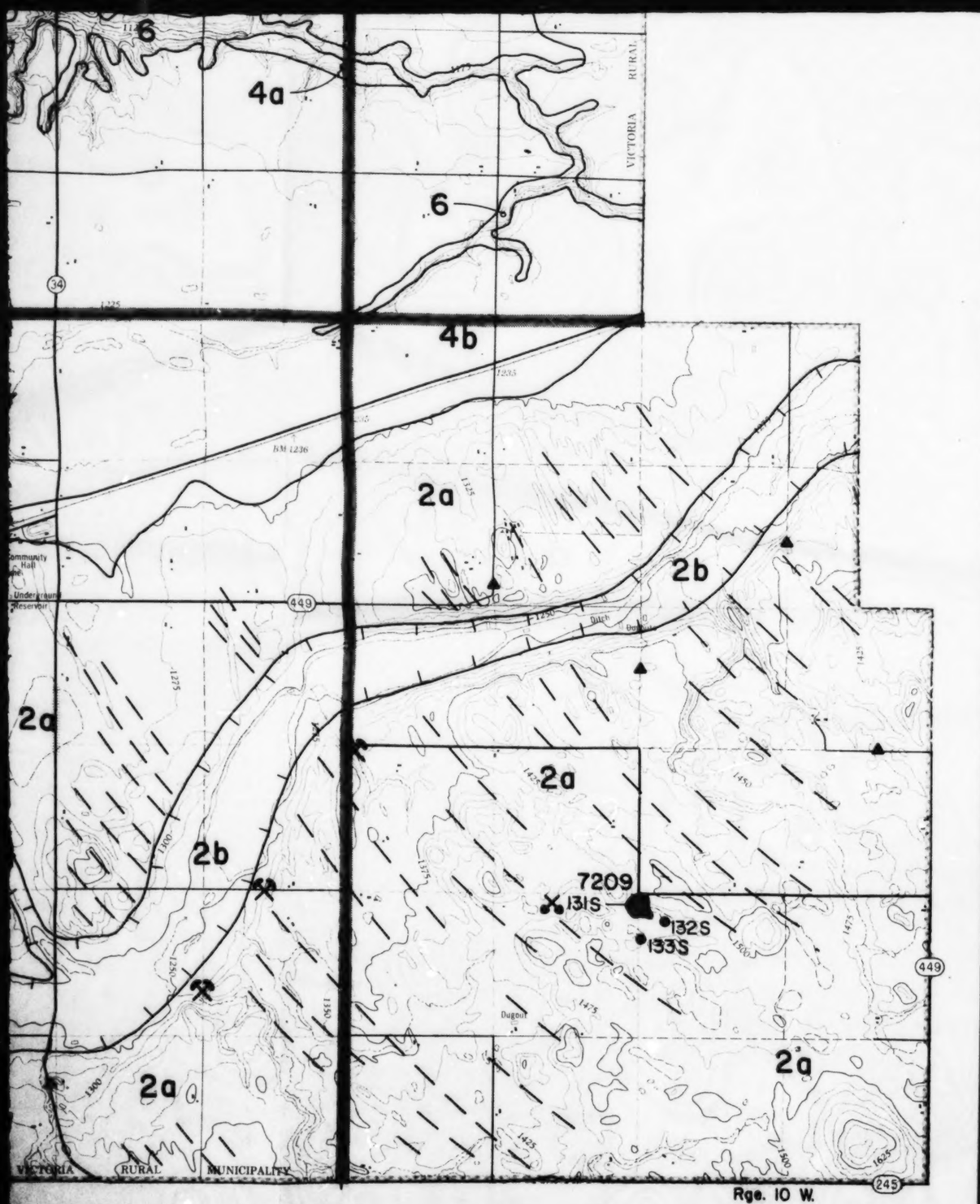
Note: Gravel is c



SURF
AGGREGAT
RURAL MU

Prepared for:
Manitoba Energy & Mines
Mineral Resources Division

To accompany Manitoba Energy and M



Medium to High Quality - >25% Gravel Content

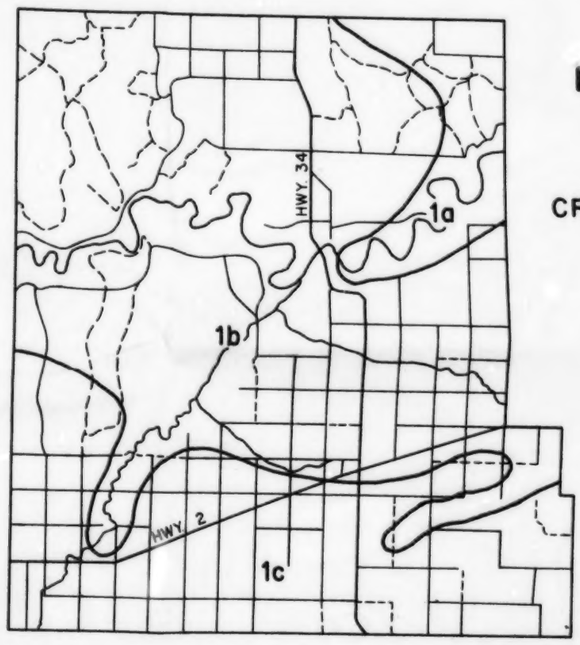
Low Quality - < 25% Gravel Content

Note: Gravel is classified as material greater than 2mm

Scale 1 : 50000

0 0.25 0.5 1.0 2.0 Miles

0 0.5 1.0 2.0 3.0 Kilometres



BEDROCK GEOLOGY MAP

(FROM HALSTEAD, 1959)

CRETACEOUS

- 1c ..... RIDING MOUNTAIN FORMATION
- 1b ..... VERMILION RIVER FORMATION
- 1a ..... FAVEL FORMATION

Scale 1 : 250 000

N

SURFICIAL GEOLOGY AND AGGREGATE RESOURCE INVENTORY OF THE RURAL MUNICIPALITY OF VICTORIA

Prepared for:
Manitoba Energy & Mines
Mineral Resources Division

Prepared by:
Underwood McLellan Ltd.
Consulting Engineers and Planners

Map No.
AR 84 - 4

To accompany Manitoba Energy and Mines Aggregate Report AR 84-4